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EXPERIMENTS ON THE CONTROL OF PINK COB-ROT OF MAIZE.

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A DRY-ROT disease of maize-cobs has caused severe crop losses from time to time in the Poverty Bay and Bay of Plenty districts. During the 1932–33 season it was particularly prevalent and gave cause for grave concern to growers. It again appeared in the 1933–34 crops, but not to any increased extent. Very few signs of the disease have been observed during the current exceptionally dry season, 1934–35.

APPEARANCE OF THE DISEASE.

Affected cobs are light in weight and have a dry, unhealthy appearance. Between and over the kernels appears a white to pink weft of fungus-strands extending from the silk end towards the base of the cob. The kernels are dry, shrunken, light in weight, somewhat loose in their sockets, and, in cases of early infection, may be largely missing from the silk end. The sheath may be discoloured and partly cemented to the cob by fungus-strands.

In the seedling stage the fungus attacks both the shoot and the root. If the seed is infected severely this attack takes place simultaneously with germination, and the seedling dies before emergence. In most cases, however, the seedling has pushed well above soil-level before complete decay of the primary root and lower part of the shoot has taken place. Secondary roots are then pushed out near the surface-level and these take up the work of nourishing the growing plant. These secondary roots seldom show signs of infection, and the plant thereafter develops apparently free from the disease.

CAUSAL ORGANISM.

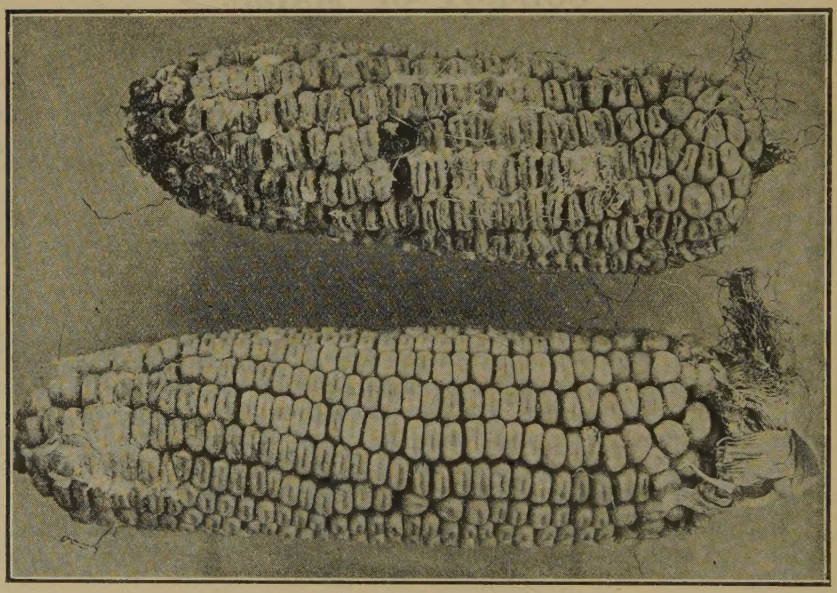
Cultures from diseased cobs have constantly yielded the fungus *Fusarium moniliforme* Sheld. var. *subglutinans* Reink. and Wollenw.* *Fusarium moniliforme* has been reported from most countries as causing a pink cob-root and seedling-mortality of maize. The same species also occurs on a wide range of cereals and grasses, but there

* Cultures of the fungus so identified by S. F. Ashby, Imperial Mycologica Institute, Kew.

is no evidence to show whether or not the strain causing this disease is specific to maize. The question is of some importance as affecting control, since if maize is the only source of infection, then complete elimination of all remnants of previous crops should prevent re-infection of the new.

Summary of Literature.

A *Fusarium* cob-rot of maize, which is apparently identical with the disease dealt with in the present article, has been recorded in most maize-growing countries. Several workers have shown that diseased seed yields a less emergence of seedlings than healthy seed, but that, when once established, there is little difference between the plants.



PINK COB-ROT OF MAIZE.

[*Photo by H. Drake.*

Seed-treatments, especially with organic mercury dusts, generally show improvement in yield when used with heavily infected seed, and little or none with healthy seed. No direct connection has been traced between infected seed and diseased cobs, and it is generally held that infection of the latter is due to air-borne spores, which first attack the silk and then spread to the grain. The origin of this infection is frequently ascribed to remnants of previous crops, and control methods usually take the form of advice to collect and burn all such remnants, and to refrain from growing maize for two seasons on land which has carried an infected crop.

Experiments on Control.

Experiments on disinfection were carried out on highly infected maize seed with hot water, and with organic mercury dusts and

steep. After treatment the seed was dried and samples sown in sterile sand in open trays, the resultant plants being pulled and examined for root lesions. Other samples were germinated on sterile filter pads in petri dishes, being examined for the appearance of the *Fusarium*.

Table of Results.

Treatment.	Number.					
	Sown.		Germinated.		Diseased.	
	Sand.	Pads.	Sand.	Pads.	Sand.	Pads.
Untreated control	100	20	92	15	70	20
Hot water, ten minutes at 125° ..	50	20	45	17	10	8
Hot water, ten minutes at 130° ..	50	20	43	16	6	8
Hot water, ten minutes at 135° ..	50	20	47	17	0	3
Hot water, ten minutes at 140° ..	50	20	45	19	0	0
Hot water, ten minutes at 145° ..	50	20	37	14	0	0
Organic mercury steeps—						
"Uspulun" 0·25 per cent., 1 hour..	50	20	46	16	0	13
"Uspulun" 0·25 per cent., 2 hours	50	20	45	17	1	15
Dusts—						
"Agrosan G," 2 oz. per bushel ..	50	..	45	..	2	..
"Ceresan New," 2 oz. per bushel ..	50	..	46	..	0	..

A third series of ten-minute hot-water treatments, put to germinate on sterile pads in petri dishes, ranging by 2° intervals from 134° to 150° showed complete disinfection of the seed at 138° and upwards, with no germination injury up to 142°, and thereafter a steady increase in injury up to 150°.

Field trials on the effect of seed disinfection on the incidence of cob-rot were carried out at the Plant Research Station, Palmerston North, during the 1933–34 season. Two blocks of land (A and B) were used, one being sown with untreated and dusted seed, and the other with hot-water-treated seed only. These blocks were about two miles apart and neither had grown maize previously, nor was there any maize in the vicinity. The seed used was hand-shelled from cobs collected from an infected crop at Te Puke, Bay of Plenty. Sowing was done by hand, three seeds per hill, the hills being 3 ft. apart each way.

On Block A 280 hills were sown with seed dusted at the rate of 2 oz. per bushel with "Ceresan," 336 hills with seed dusted with "Agrosan G" at 2 oz. per bushel, 336 hills with seed from the same bulk untreated, and 198 hills with untreated seed taken from specially selected heavily *Fusarium*-infected cobs.

For Block B, all the seed was treated by a dip of ten minutes in water held at 143° F. This reduced the germination on filter pads from 94 per cent. to 79 per cent., the untreated seed showing 30 per cent. infection with *Fusarium* and the treated seed being apparently free from fungi. Part of this block was sown with hot-water-treated seed which had in addition a dust treatment of 2 oz. per bushel of "Ceresan," and part similarly dusted using "Agrosan G."

On Block A counts were made following germination of the number of hills in which the full number of plants had established, and at harvest the number of sound, of malformed, and of diseased cobs was recorded for each treatment.

On Block B no comparative germination counts were taken, on account of irregular seedling-damage caused by birds. At harvest plants from the "Ceresan" and "Agrosan G" treated seed were counted together for comparison with those from seed that had been hot-water-treated alone.

In both blocks the seedlings were thinned to not more than two per hill. Sowing took place on the 8th and 9th November, 1933, and harvest early in June, 1934.

Table of Results.

Treatment.	Total.		Percentage of Cobs.			Percentage of Hills with Full Germination.
	Hills.	Cobs.	Normal.	Malformed.	Diseased.	
BLOCK A.						
Dusted "Ceresan" ..	280	776	55·0	40·5	4·5	73
Dusted "Agrosan G"..	336	961	58·0	37·0	5·0	85
Untreated	336	985	54·0	40·6	5·4	66
Diseased seed untreated	168	417	48·6	46·0	5·4	17
BLOCK B.						
Hot-water-treated ..	1,300	3,628	69·4	24·8	5·6	..
Hot water plus "Ceresan" and "Agrosan G" dusts	665	1,799	71·1	22·2	6·6	..

SUMMARY OF RESULTS.

It was found that maize seed infected with *Fusarium moniliforme* could be disinfected with little injury to germination by a dip of ten minutes in water held at from 138° F. to 142° F. Plants from infected seed treated with organic mercury dusts and steep, grown in sterile sand, remained nearly free from root lesions when corresponding plants from untreated seed were severely affected.

In the field the amount of cob-rot which developed bore no relation to the degree of infection of the seed. Highly infected seed produced no more diseased cobs than lightly infected seed, and less than disinfected seed grown in another locality.

The field germination of highly infected seed was much below that of lightly infected seed, and was improved for the latter by dusting with organic mercury preparations.

SUGGESTIONS TO GROWERS.

Since no reduction of cob-rot is to be expected from seed-disinfection, elimination of sources of air-borne infection, by the burning of all maize refuse and by crop rotation, offers the most feasible means of control. Organic mercury dusts ("Agrosan G" or "Ceresan"), at 2 oz. per bushel, largely control seedling mortality from the disease. This treatment costs about 5d. per bushel of seed, and can be carried out at any time between harvest and sowing. Dusted seed keeps at least as well as undusted, and is safe from rodent or insect attack.

The dust and seed should be mixed thoroughly in a dust-tight container —mixing on a floor or in a sack is wasteful and inefficient. Particulars of the construction of a cheap home-made dusting-machine may be obtained from the makers of these dusts or from Instructors in Agriculture.

The writers desire to acknowledge with thanks the assistance given in this work by Mr. C. Walker, Instructor in Agriculture, Te Puke, who supplied the information herein contained on the field distribution and incidence of the disease, and also the diseased material used in the experiments.

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FARMING IN THE AUCKLAND PROVINCE.

OBSERVATIONS ON FARM-MANAGEMENT METHODS.

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(Concluded.)

WHANGAREI COUNTY.

June 14th, 1934: Poroti to Puwera.—Inspected a settlement of gum-land farms at Poroti, and thence through the basic volcanic-soil areas of Whatitiri, Maungatapere, and Maunu, and up the Otaika Valley to the old Experimental Farm at Puwera. The gum-land at Poroti shows some interesting features, the soil being a mixture of clays and grey silts. On the silts, mature podsols, there is an impervious pan which prevents surface drainage. Parts of the land are hopelessly boggy in the winter and bake hard and dry in the summer. In its natural state the soil carries a surface-covering of rushes and umbrella fern. When grassed, without drainage, rye-grass and white clover often die, and the only plants to survive are paspalum and *Lotus major*. In the summer it seems that it would be impossible to drain this land owing to the hardness of the soil, but in winter, if drains are dug down to the hard pan, the water and air soon soften the cement-like pan, and the drain can be easily dug through to the clay beneath. The best drains for this sort of land are underground fascine drains made of manuka, which were so successfully used (by Patterson(4)) on similar land at the Puwera Experimental Farm. Long manuka, which is found growing in most of the valleys on gum land, is tied into bundles 6 in. or 8 in. in diameter and wedged into the bottom of a V-shaped drain. Surface drains are of no use—the actual water-table must be lowered by underground drainage.

The basic volcanic soil areas from Whatitiri through Maungatapere to Maunu made a welcome change of scenery to the grey undeveloped gum-land areas. Originally heavily forested, this volcanic country looks and is good land: with its rich green pastures, neat stone walls, and beautiful trees—principally groves of puriri. The basaltic-lava flows and scoria cones give rise to fertile soils—rich friable red or brown loams, commonly known as volcanic land. The only fault that they have is drying out badly in the summer. Before top-dressing was a common practice a good deal of the pasture on these soils was poor and contained a lot of ribgrass and brown-top: subterranean clover was, and still is, fairly common—quite a good indication of a soil that dries out badly in the summer. Most of this volcanic land is devoted to dairying. The general butterfat-production per acre for the whole land farmed is not high, on account of most farms still having considerable areas of partly improved land that is covered in stones, fern, and poor grass.

Visited a dairy-farm on the volcanic land that I had not been on since 1928, when the farm was in the course of being broken in from a condition of rough stony pasture of ratstail, danthonia, and buffalo grass. The pastures, particularly the ones closed for winter feed, showed an excellent growth of grass. Cocksfoot and rye-grass were growing splendidly—the cocksfoot growth especially caught my eye, as I had only the week before been up in the Rotorua District, where all the cocksfoot had been whitened by early winter frosts.

In sowing down this light volcanic land to grass, consolidation is just as important as on other classes of land. I recently saw a partial failure of grass on this land caused through the farmer trying to do things too well and yet omitting that very necessary consolidation of the seed-bed, without which a good establishment of grass and clover cannot be obtained. It was a field of light volcanic land which had been under annual crops for two or three years and on which the farmer desired to get a first-class rye-grass and white clover pasture. Thinking he would do the land particularly well, he sowed a crop of lupins and ploughed them in prior to sowing the grass. He omitted to consolidate the seed-bed properly and the strike of grass and clover was poor, and only round the gateways, where the land was consolidated by moving implements, was a good strike obtained. Now, the heavy clay land should be consolidated by allowing the land to settle: light land, on the other hand, wants to be consolidated with the Cambridge roller. To consolidate the bottom of the seed-bed the land should be rolled on the furrow after ploughing. The roller pushes the furrow slices together and firms the bottom of the seed-bed.

There is a good deal of gum-land development going on up the Otaika Valley—mostly Crown settlers established under the Land Laws Amendment Act, 1929. It was very interesting to see again some of the pastures on the Puwera Farm—good pastures of perennial rye, paspalum, and white clover on what was looked on originally as a hopeless soil. Water is short on most of this gum land, and stock have to be supplied in the summer from water held in the valleys by means of dams: this dam water is not good for stock, and bore water cannot be obtained.

I saw a team of six bullocks disking an area of ploughed gum land. It is curious how the old and new so often exist side by side in farming. It is generally considered that modern farm tractors are the last word in farm equipment, and yet here were bullocks doing excellent work, and probably cheaper work than could be done with horses or tractors. The argument as to whether bullocks or horses were the best for farm-cultivation work started in the Middle Ages and lasted down to the time of Arthur Young, who summarizes the chief point in favour of bullocks by stating "Ox teams are maintained in the winter at much less expense than horses." For small-scale breaking in of gum land there is much to be said in favour of using bullocks. Some time ago I visited a settlement on gum land where practically every horse the settlers started with had died. Certainly the horses were probably poor and old to start with, but some had died from poor feeding, some had broken their necks or got hopelessly bogged getting down to drink at water-holes. A favourite method of wintering stock on newly developed gum land is to turn them out on the unimproved gum-land hills which have been burnt off the previous summer: here the feed consists of young rushes and danthonia. A farm horse soon dies on this diet, but a working bullock pulls through. Horses for breaking in land should be hard fed.

March 21st, 1934: Whangarei.—Visited the Small-farm-plan Settlement on the tidal reclamation area at Pohe Island. These tidal flats were stopbanked and floodgated by the Whangarei Harbour Board in 1925 (5). After the salt water had been shut off for three years, some experimental grass-sowings were put down by the Department of Agriculture, and in 1933 the remainder of the area was sown to grass for small-farm-plan settlement. Open drains were first dug connecting with the main bank drain opening through the stopbank by means of floodgates, then parts of the area were underdrained with manuka fascine drains 2 chains apart. Good rye-grass, strawberry clover, and white clover pastures have been established, particularly on the areas that were underdrained. Strawberry clover is an excellent pasture plant on these areas, which until recently were covered with salt water. It will grow on land with quite a fair salt content, and is an excellent pioneer plant on areas not yet ready for grassing. In a pasture it occupies a similar place to white clover, which it resembles in a general way in foliage and habit of growth. This reclaimed tidal land in good rye-grass and strawberry clover pasture is excellent fattening country, and the development and grassing of this tidal land is receiving attention.

November 8th, 1934: Whangarei to Parua Bay.—A belt of greywacke highlands extends on the east coast from Cape Brett to Parua Bay: it is rugged country partly bush covered and partly grassed, with peaks reaching heights of 1,500 ft. The road from Whangarei to Parua Bay follows the coast, and for the first part of the journey—from Whangarei to Onerahi—the points consist of basalt. The hill pastures are mainly paspalum and danthonia with some ratstail near the coast, and buffalo-grass on the flats and lower slopes. In other districts such country is almost entirely given over to sheep, but here most of the farms appear to be milking quite a lot of cows. The best pastures—on the easy hills where the land has been ploughed—consist of rye-grass, paspalum, and white clover, and have quite a reasonable per-acre butterfat-production;

but on the steep hills where there is only danthonia, brown-top, and paspalum, without any clovers, the per-acre production of butterfat must be very low—for, without clovers, paspalum on this class of country does not throw a great deal of feed.

November 8th, 1934: Whangarei to Ngunguru to Hikurangi.—For the first part of the journey the road follows a long neck of basaltic volcanic land to Kiripaka and thence through steep greywacke hill country. Pastures are mainly danthonia and paspalum, with areas which have reverted to fern and manuka. Examined a sowing on a secondary manuka burn which had been sown last autumn. The grass mixture used had consisted of perennial rye, cocksfoot, and white clover: quite a good take had been secured on the manuka burn, and a remarkably good one on a small patch of light bush which had been included in the sowing. Now, this steep hill-country can be grassed successfully with rye-grass and white clover only if it is regularly, even though lightly, top-dressed. Without added phosphates, white clover does not persist, and without white clover rye-grass does not flourish. A high degree of fertility must be maintained for rye-grass. If top-dressing is not to be carried out, danthonia, brown-top, and dogstail are required in the grass mixture.

Paspalum has a place on this hill-country, but it demands fairly high soil fertility for good growth: on really poor dry soil it rapidly becomes sod-bound and produces little feed; on dry and hard hill-country reliance must be placed on danthonia and other low fertility demanding plants. Where the soil is moist, or fertility is kept up with top-dressing, paspalum is an excellent hill-country grass. It is particularly valuable for dealing with secondary growth, for it will thrive and persist under the shade of fairly tall fern and scrub and will recover after burning.

The bulk of the hill-country pastures in this area consist of danthonia and paspalum without much clover, and any top-dressing that is done on old grassland should be preceded and accompanied by the sowing of *Lotus major* and white-clover seed. *Lotus major* is a valuable plant on hill-country, although it is slow to establish. The plants cannot be introduced directly into a tight sward: the best plan is to sow the seed on bare knolls and where the soil is loose. November and December are the best months for sowing seed. Once established, the seed is spread out into the sward through cattle droppings. Close and continuous grazing hinders the establishment and spread of *Lotus major*: easing up grazing in the summer allows the plants to seed.

This greywacke highland forms the watershed between the east and west coasts, and returning to Hikurangi one looks over the rectangular central basin in which lies the Hikurangi Swamp, which is drained by the Wairua Stream flowing to the west coast through the gap between the Maunguru and Tangihua Ranges. The Hikurangi Swamp has recently been drained, and this has done away with prolonged winter-flooding to which the area was subject prior to drainage. The swamp consists of a central area near Hikurangi, with long arms extending into the hills surrounding the swamp. The soil is heavy, and was for the most part originally covered in heavy manuka. The pastures consist almost entirely of paspalum, and this is the common type of pasture on most of the land in North Auckland which has been

subject to flooding. With the present drainage many of these pure-paspalum swards could be improved to carry rye-grass and white clover along with the paspalum.

BAY OF ISLANDS COUNTY.

February 18th, 1935: Hukerenui to Ohaeawai.—At Hukerenui long sprawling spurs of Onerahi claystone run out into the valley of the Waipuakakahau Stream. There is some very good gum-land development work going on here. From Hukerenui to Kawakawa the country on the east consists of greywacke hills through which occur areas of basic volcanic soil, and on the west of these hills are low undulating gum-land areas on Onerahi claystones.

Ohaeawai is situated on a volcanic plateau of basaltic lava flows, dotted with steep-sided scoria cones. A pleasant farming district with well-cultivated farms and beautiful trees—groves of puriri and oaks planted by the early settlers. A good deal of the volcanic land is stony and is covered in danthonia and gorse, the latter neatly trimmed by sheep. Beyond Okaihau towards Kerikeri Inlet of the Bay of Islands lies a large area of unoccupied volcanic land underlain by old lava flows (locally known as "ironstone land" from the lumps of red ochre and limonite which strew its surface). The soil is thin and poor; the country is covered in low manuka scrub, bracken fern, and small kumarahou scrub. The Australian plant *Hakea avicularis* is rapidly spreading over this land, and in places is now the chief plant.

I stopped at a farm where some of this poor ironstone land is being cultivated. The land was cleared, ploughed, and sown in grass two years ago, but except where heavy applications of lime (1 ton and 2 tons per acre) had been applied, the results were poor. These soils are known as laterites and lateritic soils; like the grey gum-land silts their infertility is due to excessive leaching, but the process has been different in the two classes of soil. These soils show a zoned or banded appearance. On examination in one road-cutting the soil showed the following layers: First 12 in. of brown granular clay, then from 1 to 2 in. of yellowish brown soil with nodules of iron, then up to 5 in. of dull-brown granular clay on a reddish-brown nodular layer. The prolonged leaching that these soils have been exposed to has washed out the bases, and the soils lack potash and lime and are deficient in available phosphates. Iron compounds are present in sufficient quantities to render small dressings of phosphates of little value(2).

The good basic volcanic soils form the chief farming-areas of the Bay of Islands County, and farms are chiefly devoted to dairying and fat-lamb raising. These volcanic soils dry out rather badly in a dry summer, and pasture-production could be improved by the inclusion of paspalum in the grass mixtures on ploughed land. This season the summer rainfall has been very heavy and the pasture lands are looking remarkably well.

HOKIANGA COUNTY.

February 19th, 1935: Rangiahua to Maungamuka.—The main road skirts the eastern end of Hokianga Harbour and continues north into Mangonui County, rising sharply from Maungamuka over a saddle on the hills separating the Hokianga River Valley and Victoria Valley in

Mangonui County. I was first through this district in 1921, and a good many changes have taken place since then. Road improvement has been most marked, and in place of the impassable clay roads there are now fine metalled highways. Dairy-farm pastures show a marked improvement, though there appears on many surface-sown hill-country farms a good deal of reversion to fern and manuka. Pastures on the flat and low undulating limestone foothills are dominantly paspalum, and are pastures of high productivity. Originally the land was covered in mixed heavy bush and was surface-sown. Successful pasture management, particularly on dairy-farms, has followed the lines of clearing up bush-burn debris, harrowing, and top-dressing. Considerable areas of undulating country have been ploughed and resown to grass, and this certainly gives the best results. Without top-dressing and harrowing the paspalum pastures on undulating land get very tight swards, with a poor clover growth, and the spring growth becomes increasingly late.

Farming in the Hokianga County consists in grazing Romney sheep and beef cattle on surface-sown hill-country and dairy-farming on the flat and undulating land in the river valleys. Dairy-farming is extensive rather than intensive. Little supplementary cropping is done, and only a small area is annually harvested for hay and ensilage. There are 142,000 acres of sown grass in the county, with 500 acres devoted to annual crops and 900 acres cut for hay and ensilage to provide winter keep for 19,000 dairy cows. In this district, with its abundant paspalum pastures, summer supplementary feeding is not usually required, and the rank autumn growth on paspalum fields is used for winter feeding. The weakness of the system lies in the shortage of good early spring feed.

I visited a dairy-farm on what until recently was part of a sheep- and cattle-grazing run. The flats were rich paspalum pastures, but the hills had some paspalum with a good deal of bracken fern. In handling this hill-country with dairy cows the bracken cannot be crushed out. It must be got rid of by either cutting or harrowing, and this latter method is used a good deal in Hokianga. With the bracken cleared away, the next problem is to improve the sward with rye-grass and white clover. Some sort of a seed-bed is required—it is useless to sow on a hard, bare surface : the land should be heavily harrowed if ploughing and resowing cannot be done.

The Native settlers at Maungamuka have got considerable areas under cultivation for maize. The crops look exceptionally well, but army worms have stripped the leaves on some areas. Maize grows well on the rich river-flats, and its cultivation could well be extended as an adjunct to pig-keeping.

MANGONUI COUNTY.

February 20th, 1935 : Kaitaia to Houhora.—Kaitaia lies in the valley of the Awanui River. There are areas of rich flat land in paspalum pastures from which rise low undulating scrub-covered hills : the Kaitaia Swamp lies just inside the coastal sandhills. Most of the pasture land consists of pure paspalum ; summer production is heavy, but early spring growth is poor owing to lack of rye-grass in the pastures. The summer rainfall this year has been very good, and there is a tremendous paspalum growth on some fields, which farmers are cutting for hay. A good deal of

the hay lying out looks as if it had got thoroughly wet several times, and is a very bad colour. With the weather now being experienced it would be better to abandon haymaking and cut the green stuff for silage. This heavy paspalum, with a good leafy bottom, makes excellent silage—very valuable material for feeding in the early spring when feed on these flats is scarce. Hay badly spoilt by rain is not good for feeding cows in the spring, but good silage is excellent. The same thing is observable now in other parts of the North. If the weather is really unsettled it is not worth while "poking about" making hay when the alternative of ensilage is available. Waikato farmers learnt this long ago, but ensilage, although common in parts of the North, has not yet extended to all dairy-farms.

Beyond Waipapakauri stretches the long sandy peninsula of the Ninety-mile Beach. On these hills are found three distinct formations—moving dunes, which are now being stabilized by the planting of marram grass; recently consolidated sandy hills covered in manuka and fern, which are being fairly rapidly developed for dairy-farming; and older consolidated sandy hills where the surface soil has been badly leached, where drainage is bad and rushes are one of the main features of the vegetation: on these the iron podsol type of soil has been developed. An examination of a road-cutting at Waipapakauri on this leached soil showed the following banded formation: First 10 in. of a dark humus layer, then 4 in. or 5 in. of a light-coloured leached layer, then 9 in. of a darker layer which has been enriched by material from the upper layers, followed by irregular layers of hard pans with a deep continuous pan 4 ft. or 5 ft. down: this last pan is hard and impervious. The pans are formed by the humus and iron washed out of the surface layers cementing the sand particles together. It is these hard pans, which follow an irregular and complicated course, that render these older consolidated sands infertile.

The areas of recently consolidated sand which have not been leached like the older areas make quite good dairying land, and are being fairly rapidly developed for this purpose. They will carry good rye-grass, paspalum, white-clover swards, but most of the grassed areas consist of paspalum and subterranean clover—quite a fair pasture and one that can be established reasonably well with fairly primitive methods of cultivation. Where the aim is to establish a dominant rye-grass pasture, white is the best clover; but if rye-grass is not desired owing to the high degree of fertility which must be maintained for it to do well, then paspalum and subterranean clover make quite a good combination. Subterranean clover throws feed in the winter and early spring when the paspalum is dormant. For the establishment of first-class rye-grass, paspalum, and white-clover pastures the preliminary cultivation work must be good; perennial strains of rye-grass and white clover must be sown, and the land well manured with phosphates.

Between the sandhills lie old kauri swamps full of logs and stumps, and also peat areas which are here and there being developed. Drainage of peat lands wants to be done slowly and carefully. If the water is taken off too rapidly the peat dries out very badly; when really dried out, peat land is almost impossible to grass. On some of these peat areas I examined, a remarkable improvement

in pasture growth had been brought about with applications of superphosphate. Lime on these pastures had given little or no response. Some peat swamps respond to lime and others do not; the only satisfactory way to settle the matter is to try liming on a small plot.

February 21st, 1935: Awanui to Oruaiti via Lake Ohia and Mangonui.—The road from Awanui to Mangonui via Lake Ohia crosses a long series of unoccupied dismal-looking scrub- and rush-covered hills—rolling hills of sands, silts, and clays—the soils all showing the effect of excessive leaching. On the sands the soil profile shows a layer of sandy peat, then a layer of light leached sand, then a dark layer which has been enriched by humus carried down by water, then light sand, below which is a layer of dark cemented sand. The clays also show effects of leaching: first a thin humus layer, then a grey leached layer of silt below which is the unaltered clay. This is a poor infertile tract of land. The climate is good and no doubt the land will be developed some day, but it is likely to remain in its present condition until prices for primary products improve considerably. Beyond Mangonui the road traverses long stretches of dry red volcanic land on undulating scrub-covered hills. This volcanic land is very dry, and although it has not been critically examined its infertility is probably due to leaching. Quite a large area of Mangonui County is still unoccupied and unimproved. On this journey the road covered thirty-five miles of dreary scrub-covered hills with only a handful of actual farms.

WHANGAROA COUNTY.

February 21st, 1935: Kaeo to Keri Keri Plains.—Whangaroa County is the smallest in New Zealand: it has only 27,000 acres in sown grass, which carry 4,000 dairy cows, 4,000 other cattle, and 18,000 sheep. Dairy-farming is confined to the flat alluvial soils in the river valleys.

A certain amount of development work in the reclamation of tidal flats is proceeding at the head of the Whangaroa Harbour. The reclamation work on some of the flats was started a good many years ago, and pasture establishment has been brought about mainly by the slow spread of paspalum. On the reclaimed areas drainage is carried out with shallow open drains which are not particularly satisfactory. Open drains, unless deep and frequent, do not lower the permanent water-level: underground drains are required. Much more rapid improvement could be brought about if the reclaimed areas were underdrained with manuka-fascine drains. There is plenty of tall manuka on the foothills which could be used for this purpose. Underground drainage is necessary for rye-grass establishment.

Whangaroa County contains the northern end of the Keri Keri Plains—ironstone land which has already been described in Bay of Islands County.

SUMMARY.

We have traversed the whole peninsula from Auckland City to the far North and have seen the mountain ranges, the rolling hills of claystone, sandstone, and limestone, the scoria cones and volcanic plateau, the areas of consolidated sand, and flat alluvial land.

There are many places we have not been to and many things we have not seen. Some counties we have only glanced at; the native forest, now remaining only on the mountain-tops, we have passed by: there are areas afforested with *Pinus radiata* trees and tung oil and flax plantations that have not been examined.

A traveller to North Auckland immediately is struck by the amount of unoccupied scrub-covered land—surface-sown hill-country that has reverted to fern and manuka and open scrub country that has not been developed. The infertility of much of the open scrub country is due to the long-continued effect of soil-leaching. A good deal of these apparently infertile soils has already been developed: as prices for primary products improve more will be dealt with. Good cultivation, lime and phosphates, and perennial strains of grass and clover are all essential in bringing-in most of this poor soil. We leave North Auckland with the feeling that it offers great scope for future farm development.

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(4) PATTERSON, T. H., Instructor in Agriculture, Auckland, 1920–1928: See this *Journal*, May, 1921, Vol. XXII, No. 5, p. 257.

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POTATO-GROWING IN NEW ZEALAND.

II.—DESCRIPTION OF VARIETIES.

R. THOMSON, Assistant in Agronomy, Government Pure-seed Station, Lincoln.

(Concluded.)

JERSEY BENNES.

Origin.—Not known, but the variety appears to be identical with International Kidney, which is the chief variety of the Jersey early potato trade. International Kidney was raised by R. Fenn, Sulhampstead, and introduced by Dean in 1879.

Foliage.—Haulm of medium height and vigour, fairly upright and open. Stem, colour 3. Wings inconspicuous. Stem nearly round. Leaf close, glossy; leaflets dark green, rounded, edges waved, terminals tied; secondaries large and numerous.

Flower.—White, small, rare; buds dark, drop early; flower-stalk fairly short.

Tubers.—Kidney (oval). Skin white and smooth. Eyes shallow. Eyebrow distinct. Flesh pale lemon. Sprouts blue.

Maturity.—First early.

Notes.—A variety which has gained favour during the last few seasons, more particularly in the southern part of the South Island. Its excellent shape combined with its earliness recommends it, but it requires sheltered situations. Certified lines are available.

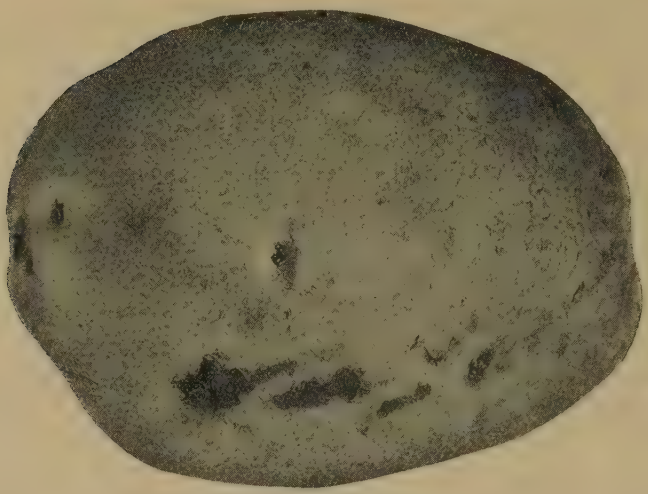

FIG. 17. JERSEY BENNES.

KERR'S PINK.

Origin.—Fortyfold X Smith's Early. Raised by James Henry, of Ottawa, late of Brae, Cornhill, Banffshire, in 1907. Introduced into Great Britain by Mr. Kerr, Seedsman, of Banff, in 1917.

Foliage.—Haulm tall, upright, open, and very vigorous. Stem branched, colour 2, extending to midrib of leaf and flower-stalk. Wings waved. Leaf dark green, rigid, fairly close; leaflets fairly large, broad, and pointed; secondaries large and often borne on leaflet stalks.

Flower.—White, numerous, buds dark; flower-stalk long.

Tubers.—Round and somewhat flattened, dented at heel end. Skin pink and rough. Eyes medium to deep. Eyebrow fairly distinct. Flesh white. Sprouts pink.

Maturity.—Late main crop.

Notes.—A heavy cropping variety, but requires rich land on account of the large number of tubers produced. It cannot be recommended for commercial growing, while there is a prejudice against coloured-skinned potatoes (Dakota excepted). Its cooking quality is not regarded as equal to the Dakota, and it is feared that its distribution would detrimentally affect the trade in Dakotas. A little certified seed is available.

FIG. 18. KERR'S PINK.

KING EDWARD VII.

Origin.—Raised by a Northumberland grower, who called it Fellside Hero. It eventually came into the hands of Mr. Butler, of Scottar, who named it King Edward VII, and placed it on the market in 1902.

Foliage.—Haulm tall and erect, moderately vigorous and open. Stem, colour 2, variable. Wings waved. Leaf dark green and glossy; leaflets small, narrow, pointed, edges waved, the last pair tend to enfold the terminal; secondaries numerous, not large.

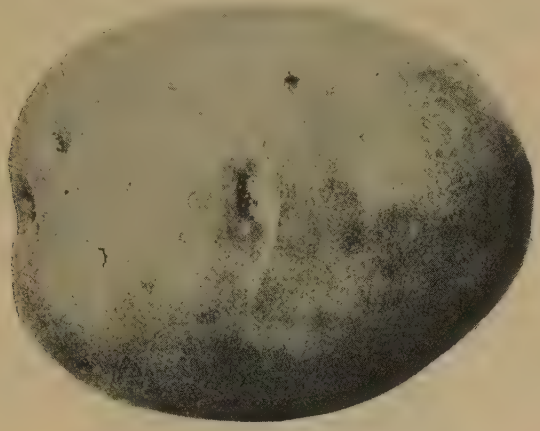

FIG. 19. KING EDWARD VII.

Flower.—Red-purple tipped with white, rare, small; flower-stalks short.

Tubers.—Oval to kidney, often tapering (pear shaped). Skin smooth, white splashed with pink. Eyes shallow. Flesh white. Sprouts pink.

Maturity.—Early main crop.

Notes.—Is grown largely in Otago and Southland, where it does very well and commands a good price on southern markets. Not recommended beyond garden culture in other districts. Its mottled colour makes it difficult to define as either a red or white potato in the trade. Red King Edward, Red King, and Rob Roy are selections from King Edward in which the tuber colour is entirely pink. Certified stocks are available.

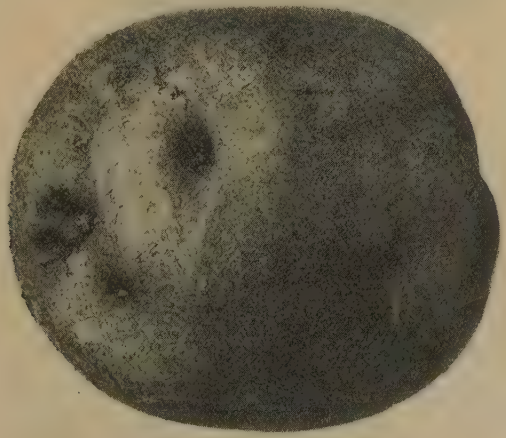

FIG. 20. LEADER.

LEADER.

Origin.—Unknown.

Foliage.—Haulm tall, upright, vigorous, and medium open. Stem, colour 2, particularly at nodes and leaf axils. Wings waved. Leaf distinct greyish-green when compared with Dakota; leaflets medium broad; secondaries small.

Flowers.—White, large; tall and prominent.

Tubers.—Round, often depressed at heel. Skin red and rough. Eyes fairly shallow. Flesh distinctly yellow. Sprouts deep pink.

Maturity.—Main crop.

Notes.—Only of importance as a rogue in Dakota stocks. Distinguished by its greyish-green foliage and yellow-fleshed tubers.

MAJESTIC.

Origin.—Raised by A. Findlay, of Auchtermuchty, Scotland, and introduced by him in 1911.

Foliage.—Haulm tall, open, and vigorous, commences to spread early. Stem, colour 0–1. Wings straight. Leaf light ashy-green, open; leaflets pointed, flat, pinkish colour in midribs when young; secondaries small and numerous.

Flower.—White, large, fairly numerous; flower-stalk long.

Tuber.—Kidney, tapering somewhat to heel end. Skin white and smooth. Eyes shallow. Eyebrow present. Flesh white. Sprouts pink.

Maturity.—Early main crop.

Notes.—Although a good cropper it cannot be recommended for commercial growing, as Aucklander Short Top is of a similar type and is much hardier. Majestic bruises very easily, and the loss sustained as a result of cutting the tubers for seed may, at times, be extremely severe. Certified seed is available.

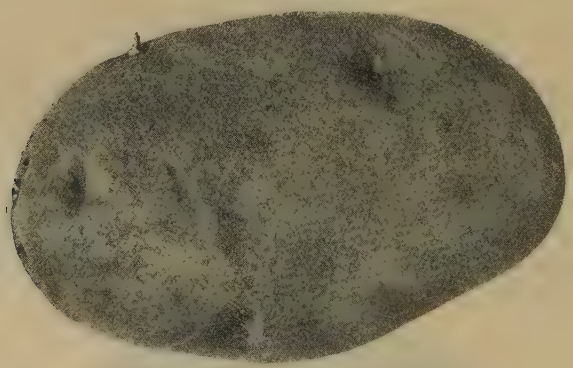

FIG. 21. MAJESTIC.

MAY QUEEN.

Origin.—Raised by E. Saddler, Bentham, and introduced by Sutton and Sons in 1900.

Foliage.—Haulm of medium height and vigour, spreading, medium compact. Stem, colour 1. Wings waved. Leaf medium green, glossy; leaflets large, curled upwards with waved margins, last pair overlap terminal; secondaries fairly large and numerous.

Flower.—Light blue-purple with white tips; fairly numerous; buds purple; flower-stalk long.

Tuber.—Kidney, sometimes tapered to heel. Skin white. Eyes shallow. Flesh white. Sprouts blue.

Maturity.—First early.

Notes.—Only suitable for garden use. Produces a fair crop of medium-sized tubers, but is a poor keeper. No certified stocks are available.

NEW ERA.

Origin.—A New Zealand selection which has been tested out in Great Britain and reported to be a bolter from Evergood. The latter was raised by A. Findlay and placed on the market in 1900. It was originally produced under the name of Eldorado. New Era, except for the roughness of the skin, corresponds with the descriptions of Evergood given by British authorities. Also known as Perfection or Perfection New Era.

Foliage.—Haulm tall, of medium vigour, upright to spreading, open. Stem, colour 0–1. Wings waved. Leaf open, dark greyish-green; leaflets crinkled, small, narrow, pointed (V shaped); secondaries small.

Flower.—Pale lavender, small, rare; buds green with coloured base, drop readily; flower-stalk long.

Tuber.—Short, oval, and flat. Skin white. Eyes shallow. Flesh lemon. Sprouts faint pink. Chief characteristic is the presence of tubers having a distinctly flaked skin; others are more or less smooth. Both types may arise from the same plant. Maturity and soil conditions may affect this characteristic.

Maturity.—Early main crop to main crop.

Notes.—Not recommended, although regarded by some as being useful in parts of the North Island on account of its resistance to late blight. Susceptible to mosaic, and very susceptible to internal brown fleck. No certified stocks are available.

FIG. 22. NEW ERA.

NEW ZEALAND WHITE ELEPHANT.

Origin.—Not known. Distinct from American White Elephant. (See New Zealand White Beauty of Hebron.)

Foliage.—Haulm very tall, vigorous, upright, and open. Stem much branched, colour 2, extending to midrib of leaf and flower-stalk. Wings large and waved and mottled blue-purple. Leaf pale green; leaflets small, fairly broad, crinkled; secondaries intermediate.

Flower.—Blue, occasional. Calyx tinged red-purple. Buds drop readily. Flower-stalk fairly short.

Tuber.—Oval, flattened at heel and notched, shape irregular, and much second growth. Eyes very deep with large bump above eye. Skin medium to smooth; white, tinge of purple at heel of freshly dug tuber. Flesh white. Sprouts blue.

Maturity.—Late main crop.

Notes.—Synonymous with Australian Snowflake. Crops heavily on moist rich land. A good garden variety of excellent table qualities, but not suitable for

commerce on account of its rough shape and the brittleness of the tubers. This variety will not be passed by the Port Graders in the South Island for the North Island trade. No certified stocks are available.

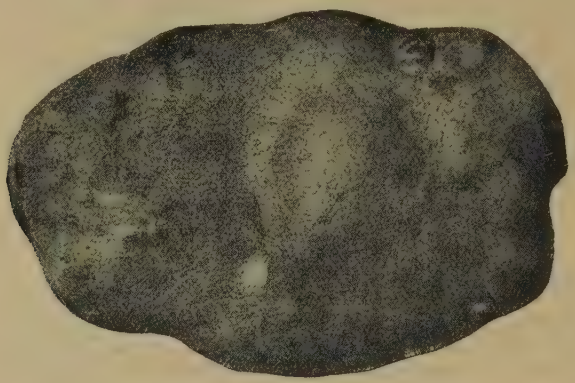

FIG. 23. NEW ZEALAND WHITE ELEPHANT.

NORTHERN STAR.

Origin.—Not known. Introduced to commerce by Findlay in 1900, and caused much excitement in Great Britain, being sold for as much as £25 per ton. It is grown under several names in New Zealand—*e.g.*, Britain's Best, Gamekeeper, &c. J. Beverley records (this *Journal*, Vol. X, p. 357) that the latter variety is distinct in the flower. The writer has grown a number of so-called variations, but under the one environment they have differed very little, if any, from typical Northern Star.

Foliage.—Haulm strong, upright, tall, and dense. Stem branching, colour 0–1, but discernible in the midribs of the young leaves. Wings waved. Leaf dark grey-green, rigid ; leaflets small, pointed ; secondaries small, moderately numerous.

Flower.—Small, white, rare, mostly drop before opening ; flower-stalk short.

Tubers.—Round. Skin white, moderately rough. Eyes medium, fairly deep at rose end. Flesh white. Sprouts pink. There is a single spot of pink in the eye most noticeable in the terminal buds, and some pink at the heel end of an immature tuber. Produces numerous long runners and small tubers.

Maturity.—Late main crop.

Notes.—Of commercial importance in the Pukekohe district only, where it is planted for an early crop, and the seed put straight back into the ground for a second late crop. Elsewhere it is the chief rogue in potato stocks on account of the large number of seed-sized tubers produced. Distinctly resistant to late blight. Maori Chief is a selection from Northern Star, having tubers splashed with purple, while Sir J. G. Wilson has all purple tubers and pale purple flowers.

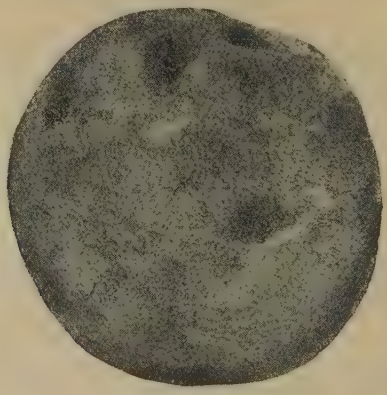

FIG. 24. NORTHERN STAR.

READING RUSSET.

Origin.—Raised by R. Fenn, Sulhampstead, and introduced by Sutton and Sons in 1882.

Foliage.—Haulm of medium height, compact, later spreading. Stem, colour 2. Wing waved. Leaf medium grey-green; leaflets long, narrow, pointed; secondaries fairly numerous, pointed.

Flower.—White, fairly numerous; flower-stalk fairly short.

Tuber.—Round, flattened. Skin deep pink, russeted. Eyes shallow. Flesh white. Sprouts deep pink.

Maturity.—Second early.

Notes.—Of no commercial importance except as a rogue in Dakota stocks. It is distinguished by its greyer-green, narrower foliage, more spreading habit, round tubers, and earlier ripening.

ROBIN ADAIR.

Origin.—Mr. J. H. Nimmo, of Nimmo and Blair, advises that many years ago this potato was grown by Mr. Shepherd at Adair, near Timaru, under the name of Cardinal. It was renamed Robin Adair by Mr. Nimmo, and has been grown ever since under that name. Robin Adair tallies fairly well with the description given by British authorities for Cardinal, except that the flower is creamy white, whereas it is red-purple in Cardinal.

Foliage.—Haulm of medium height and vigour, very spreading and open. Stem, colour 2, pronounced in axils of leaves and leaflets. Wings more or less straight. Leaf open, light green; leaflets small, rounded, terminal drooping; secondaries rounded.

Flower.—White, numerous; flower-stalk long.

Tubers.—Kidney to long, flattened, often curved. Skin red, sometimes very smooth, other times netted. The netted tuber is generally shorter and more blunt at the rose end. The variation is probably caused by environment. Eyes shallow and evenly distributed. Flesh white, often streaked with red. Sprouts pink.

Maturity.—First to second early.

Notes.—Not of great commercial importance, and very susceptible to blight. Grown mainly to supply seed for garden use, for which purpose it is very popular. Certified stocks are available. Knowler is a selection from Robin Adair in which the skin is splashed with colour. It was raised by Mr. Knowler, of Southland.

FIG. 25. ROBIN ADAIR.

SHARPE'S EXPRESS.

Origin.—Not known. Introduced to commerce by Charles Sharpe, of Sleaford, England, prior to 1901.

Foliage.—Haulm of medium height, spreading, vigorous. Stem, colour 0–1. Wings inconspicuous, waved. Leaf close, due to large and numerous secondary leaflets; leaflet bright green and glossy, distinctly pointed forward; last pair overlap terminal.

Flower.—Red-purple, rare; buds drop readily; flower-stalks short.

Tuber.—Kidney, tapering to heel end (pear-shaped). Skin white, smooth. Eyes shallow and on point of tuber. Flesh white to intermediate. Sprouts pink.

Maturity.—First early to second early.

Notes.—Only a fair cropper, and very subject to hollow heart. Cannot be recommended for commercial growing. No certified stocks available.

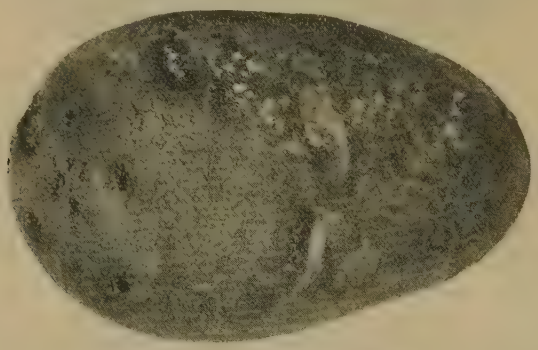

FIG. 26. SHARPE'S EXPRESS.

SCOTIA.

Origin.—Not known.

Foliage.—Haulm tall, vigorous and open, upright, but not so much as Dakota. Stem, colour 2–3. Wings more or less waved. Leaf soft grey-green due to presence of hairs; leaflets large, rounded; terminal leaflets often joined; secondaries medium.

Flower.—Blue-purple tipped white, rare; buds drop early; flower-stalk long.

Tuber.—Round. Skin red. Eyes medium, rose end deep. Flesh white, turns dark on cooking. Sprouts deep pink.

Maturity.—Main crop.

Notes.—Only of importance as a rogue in Dakota stocks. It is distinguished by its greyish foliage, fusion of the terminal leaflets, scarcity of flowers, which, if present, are blue in colour.

UP-TO-DATE.

Origin.—Introduced to commerce by A. Findlay in 1894, and said to be the result of Patterson Victoria X Blue Don. Field Marshal is identical with Up-to-Date, except that the tubers have a russet skin.

Foliage.—Haulm tall and vigorous, semi-erect, and fairly open. Stem branching, colour 1–2. Wings waved. Leaf large, fairly close, light to medium green; leaflets large, the end pair overlap the terminal; secondaries numerous.

Flower.—Light red-purple, numerous, lasting over a long period; flower-stalk long and thick. Colour shades off towards tips of petals, but is not distinctly white-tipped.

Tuber.—Oval to kidney, flattened. Skin white and smooth, sometimes roughened. Eyes shallow, mainly at rose end and on upper surface. Flesh white. Sprouts pink.

Maturity.—Main crop.

Notes.—One of the best varieties ever grown, and regarded by many as the ideal potato. A good cropper of good shape and quality. Unfortunately, stocks

deteriorate so rapidly through virus diseases that it is now of very little commercial importance. Certified stocks are available, and in districts not conducive to the spread of virus and late blight the variety is still worth growing. Bolters and wildings occur. The popularity of the variety can be judged by the fact that the Scottish Board of Agriculture reports no less than 275 synonyms.

FIG. 27. UP-TO-DATE.

WITCHILL (RESISTANT SNOWDROP).

Origin.—Produced by John Perkins, of Northampton, prior to 1881, and reselected by Dobbie and Co. as Resistant Snowdrop. The variety is of historical interest in view of the fact that it was the first to be definitely observed as immune to wart disease.

Foliage.—Haulm of medium height and vigour, spreading and dense. Stem, colour 0–1. Wings waved. Leaf medium green, open, long; leaflet long, thin, with a tendency to curl; secondaries few, small.

Flower.—White, rare; flower-stalk short; bolters flower freely.

Tuber.—Kidney (long oval), flat. Skin white, smooth. Eyes very shallow. Flesh white. Sprouts pink.

Maturity.—First early to second early.

Notes.—Susceptible to late blight; yield only fair. Cannot be recommended commercially. No certified stocks available.

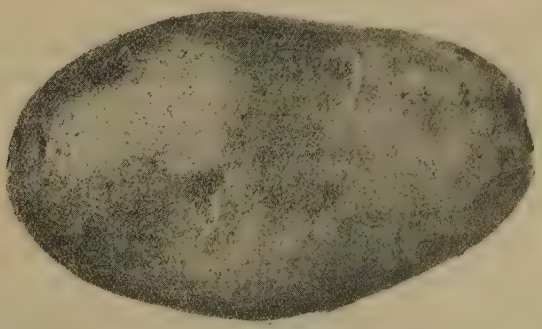

FIG. 28. WITCHILL (RESISTANT SNOWDROP).

In preparing the varietal descriptions free use has been made of information available from the following publications:—

"Potato Varieties": R. N. Salaman, M.D., Cambridge University Press.

"The Potato": Thomas P. McIntosh, B.Sc., Board of Agriculture, Scotland.

"Potato-growing for Seed Purposes": W. D. Davidson, B.A., B.Sc., Journal of Agriculture, Ireland.

"The Potato": William Stuart, U.S.A. Department of Agriculture.

"Potato Culture": J. W. Hadfield, New Zealand Department of Agriculture (Bulletin No. 142).

SORE-SHIN OF BLUE LUPINS.

ITS IDENTITY WITH PEA-MOSAIC.

E. E. CHAMBERLAIN, Mycological Laboratory, Plant Research Station, Palmerston North.

"SORE-SHIN," a destructive disease of blue lupins (*Lupinus angustifolius*), has already been described and its causal agent shown to be a virus (Neill, Brien, and Chamberlain, 1934). More recently an obscure disease of lupins has been described by Richter (1934) as occurring in Germany. From his description it would appear that the European disease is very similar to if not identical with sore-shin.

The experiments detailed in this article were undertaken to determine the relationship, if any, between sore-shin and other virus diseases occurring in the Dominion.

ARTIFICIAL CROSS-INOCULATION EXPERIMENTS.

In most cases the host range of a virus disease is confined to the members of one family of plants. Since the garden pea is a commonly grown member of the Leguminosæ, the family to which lupins belong, a preliminary attempt was made to transmit sore-shin to this plant.

EXPERIMENTAL METHOD.

Garden peas, Green-feast variety, were grown in 6 in. porous flowerpots (five plants per pot) and inoculations carried out when the plants were about 6 in. tall. The inoculum was obtained from freshly infected lupin plants collected from the field. These were pulverized in a sterile mortar and the juice strained through muslin. The inoculations were made by rubbing from six to eight leaflets of each of the healthy pea-plants with muslin moistened with the undiluted juice. A similar technique was used when cross-inoculations were made from garden peas to sweet peas and from garden peas back to lupins (see also Neill, Brien, and Chamberlain, 1934).

RESULTS.

In a preliminary experiment twenty-four pea-plants were inoculated with juice from sore-shin-infected blue lupins and twenty-four plants

left uninoculated. Of the inoculated plants six developed typical symptoms of pea-mosaic* (fig. 1), while all the uninoculated plants remained healthy.

In order to check the identity of the mosaic which developed on the pea-plants in the above experiment an attempt was made to transfer the disease to sweet peas. Using the juice of the infected plants as an inoculum twenty sweet-pea plants were inoculated. Of these, two plants developed typical pea-mosaic symptoms. Ten uninoculated sweet-pea plants remained healthy.

To ascertain whether the mosaic symptoms on the peas were brought about by the virus causing sore-shin and were not due to any chance

FIG. 1. PEA-MOSAIC. HEALTHY LEAF ON LEFT.

[Photo by H. Drake.

contamination, an attempt was made to transfer the disease back to lupins. Nine lupin plants were inoculated with juice from one of the mosaic-infected pea-plants, and of these two developed typical sore-shin symptoms. Five control plants remained healthy.

It is apparent from these experiments that the virus causing sore-shin of lupins is also capable of producing a mosaic of garden and sweet peas.

Insect Transmission.

The spread of virus diseases takes place through the agency of insects, by mechanical transmission during the handling of the plants,

* Pea-mosaic is a virus disease common on garden peas throughout New Zealand. The same virus also attacks sweet peas, broad beans, red clover, and various other clovers.

or through the soil. Since lupins are not handled during the season and transmission of virus through the soil is very rare, it seemed probable that sore-shin infection was brought about by insects. Experiments were therefore undertaken to determine whether any of the common insects known to be vectors of other virus diseases in New Zealand were concerned in the transmission of sore-shin.

A careful search, at various seasons of the year, for insects on blue lupins in the field resulted in the discovery of only one species—*Thrips tabaci**. In preliminary experiments, therefore, an attempt was made to transmit sore-shin by means of this insect.

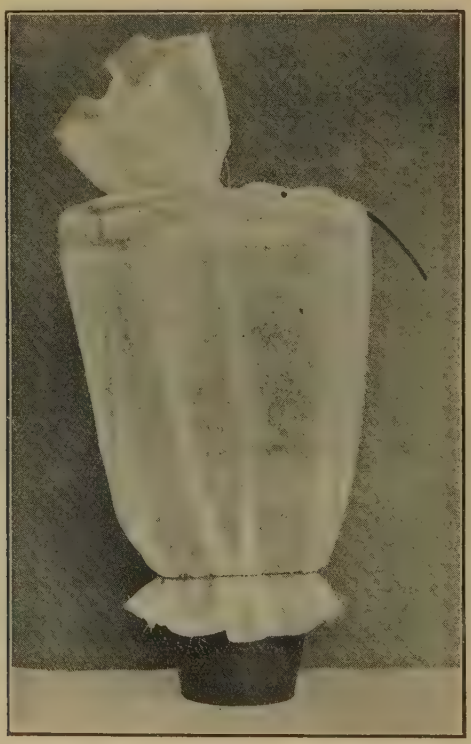

FIG. 2. MUSLIN CAGE DRAWN OVER WIRE FRAME.

The method employed for confining aphides to the lupin plants during transmission experiments. [*Photo by H. Drake.*

THRIPS.

During the summer months thrips are very plentiful on lupins, and are readily collected from the axils of the leaves.

Experimental Method.—Two methods were used for caging the thrips on the plant—(1) The method described by Cottier (1931); and (2) a method in which the thrips were confined to the lower portion of the plant by means of a lamp-chimney capped with cotton-wool.

* This identification was kindly made by Mr. J. Muggeridge, Entomologist, of this Station.

Results.—Using the first method, from twenty-five to thirty thrips, collected from infected lupins in the field, were placed on each of five plants, but no infection took place. In another experiment, using the second method, twelve thrips were added to each of twelve plants and again no infection occurred. Seventeen control plants also remained healthy.

Although these experiments were not sufficiently extensive to make the results conclusive, yet it would appear that sore-shin is not readily transmitted by thrips.

APHIDES.

Although aphides have not been observed to occur naturally on blue lupins, it was decided to attempt transmission with the two species—*Aphis rumicis* and *Myzus persicae**—which most readily transmit pea-mosaic between other legumes. The transmission was carried out in

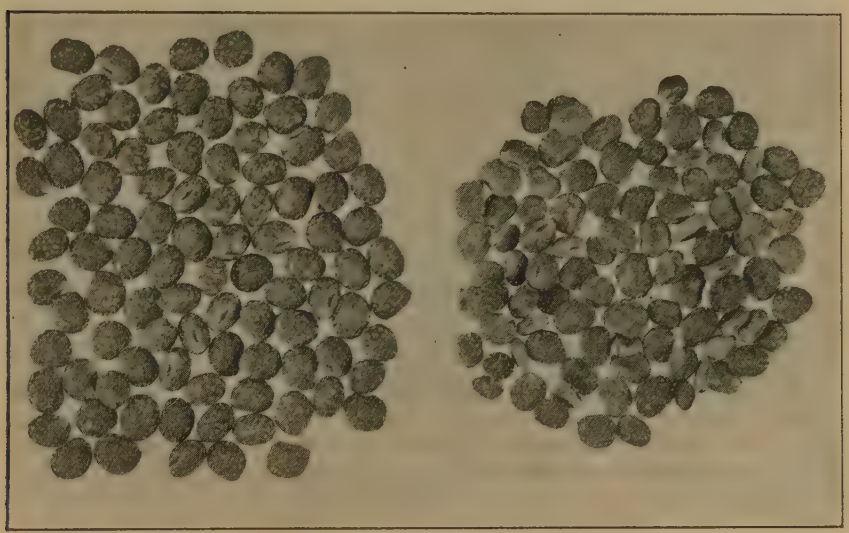

FIG. 3. EFFECT OF SORE-SHIN ON LUPIN-SEED.

Equal numbers of seeds from healthy (left) and sore-shin-infected plants.

[*Photo by H. Drake.*

each case from either mosaic-infected broad beans or garden peas. These plants were grown in the glasshouse and had been infected with mosaic from naturally infected broad beans collected from the field.

Experimental Method.—The lupins were grown in 6 in. pots (five plants per pot). The aphides were placed on the plants when the latter were about 6 in. tall. Wire frames were then fitted to the pots and muslin cages drawn over and secured (fig. 2). The check plants were treated similarly, except that no aphides were placed on them. At the end of four or five days the cages were removed and the plants fumigated, except in a few instances where all the aphides had died.

* The identification of these aphides was kindly made by Mr. W. Cottier, Assistant Entomologist, at this Station.

Results.—The results of the aphis transmission experiments are given in the following table :—

Table I.—Aphis Transmission of Sore-shin of Blue Lupins.

Date of Insect transference.	Plant from which Aphides transferred.	Species of Aphis.	Number of Aphides transferred to each Plant.	Number of Plants.	Incubation Period.*	Percentage of Plants infected.
					Days.	
8/5/34	Mosaic broad bean	*Aphis rumicis* ..	24–36	8	7	100
	..	Control ..	..	3	..	0
11/5/34	Mosaic broad bean	*Aphis rumicis* ..	12	5	Not noted	80
	..	Control ..	..	3	..	0
28/1/35	Mosaic broad bean	*Aphis rumicis* ..	12	10	6	100
	..	Control ..	..	5	..	0
5/6/35	Mosaic garden pea	*Myzus persicae*	6	17	10	12
	..	Control ..	..	13	..	0
18/6/35	Mosaic garden pea	*Myzus persicæ*	24–36	9	6	89
	..	Control ..	..	10	..	0

* The figures given in this column represent the number of days which elapsed before the first symptoms appeared. The symptoms did not appear on all plants at the same time, being delayed on some plants for from one to three days.

As a check on the diagnosis of the disease produced by aphis transmission sixteen healthy lupin-plants were artificially inoculated with juice from one of the infected plants. Four of the sixteen developed typical sore-shin symptoms, while eight uninoculated plants remained healthy.

From the results given in the above table it may be seen that sore-shin is readily transmitted by both *Aphis rumicis* and *Myzus persicae*.

Also, since the transfers were made from plants infected with naturally occurring mosaic of broad beans, it is apparent that sore-shin and broad-bean mosaic are caused by the same virus.

Seed Transmission.

Only those plants which have become infected late in the season produce any seed, and that which is formed is usually small and misshapen (fig. 3). An experiment in which 115 plants, grown from the seed of sore-shin-infected lupins, failed to develop any infection has already been recorded (Neill, Brien, and Chamberlain, 1934). Since then further trials have been carried out and a total of 405 seeds, collected from naturally infected plants, have been sown in sterilized soil in the glasshouse. Of the seed sown 315 (75 per cent.) germinated, and all the plants remained free from sore-shin. The indications are, therefore, that sore-shin is not a seed-borne disease.

Natural Method of Spread.

Since sore-shin does not appear to be seed-carried, and since lupins are not grown throughout the season, it is apparent that for spring infection to occur spread of the disease must take place from some other host. The most commonly occurring alternative host of sore-shin is red clover*, and observations suggest that this plant is implicated in the overwintering of the disease.

All plantings of red clover made at the Plant Research Station Area within the last four years have developed a high percentage of mosaic, and all crops of blue lupins grown in their vicinity have become severely infected with sore-shin (fig. 4). In the spring of 1934 blue lupins and

FIG. 4. EFFECT OF SORE-SHIN ON BLUE LUPINS IN THE FIELD.

A section of a crop showing 100-per-cent. infection grown in close proximity to a plot of mosaic-infected red-clover plants. [*Photo by H. Drake.*

Green-feast garden peas planted within 1 chain of mosaic-infected clover-plants developed 93 per cent. sore-shin and 89·5 per cent. mosaic respectively. Green-feast peas grown on another portion of the farm developed about 0·25 per cent. mosaic, and blue lupins also grown at some distance from red clover showed a sore-shin infection of about the same order.

Summary.

(1) It has been shown by cross-inoculation experiments that sore-shin of blue lupins is produced by the same virus that causes pea-mosaic.

(2) Sore-shin may be transmitted to lupins from mosaic-infected broad beans and garden peas by means of the aphides *Aphis rumicis* and *Myzus persicae*.

* A mosaic disease, which is caused by the same virus that brings about pea and broad-bean mosaic and sore-shin of lupins, is very prevalent on red clover.

(3) Experimental results indicate that the disease is not seed-carried.

(4) Observations in the field indicate that the disease overwinters as mosaic on red-clover plants.

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APHIDES AFFECTING CULTIVATED PLANTS.

(5) APHIDES OF THE BEAN, TURNIP, STRAWBERRY, PUMPKIN, AND PRIMROSE.

W. COTTIER, Entomology Section, Plant Research Station, Palmerston North.

THE common aphid of the bean is the black *Aphis rumicis*, while those of the strawberry and pumpkin are *Capitophorus fragariae* and *Aphis gossypii* respectively. There are two common aphides of the crucifer family (turnip, rape, cabbage, &c.)—viz., *Brevicoryne brassicae* and *Myzus persicae*, the latter of which has already been described in this *Journal* for May, 1935. There is also a third, *Aphis pseudobrassicae*, which does not appear to be as freely distributed as are the other two. The common aphis of the primrose is *Myzus primulae*.

Throughout the summer there are commonly encountered two forms of each aphid species—viz., the wingless and winged individuals, both being female. These forms reproduce by giving birth to living young, and are styled "viviparous" because of this characteristic. In the following accounts these two forms have been described for each species as an aid in identification.

THE BLACK BEAN APHID (APHIS RUMICIS).

The wingless viviparous female is approximately 2 mm. long and is globular in form. In colour it is usually a dull black with the first two-thirds of the antennæ very light. The legs are also very light in colour. The antennæ or "feelers" are shorter than the body.

The winged viviparous female is the same colour as is the wingless female, and approximately the same in size.

HOSTS IN NEW ZEALAND.

The writer has found this aphid on beans, *Vicia* sp., and sweet peas.

OBSERVATIONS.

This aphid is very common on all types of beans. Broad beans seem to be particularly susceptible. The black insects cluster thickly on the succulent terminal parts of the stem and shoots, causing deformation of the leaves and, in cases of severe infestation, stunting and wilting of the plants. As far as the writer is aware the life-history of this insect in New Zealand has not been worked out. Theobald

(Plant Lice of Great Britain, 1927) states that the aphid lays winter eggs on *Euonymus, Rumex*, rarely on *Viburnum opulus*, and in America on *Chenopodium*. In England this aphid is known as the "Collier" black-fly or black death, this last presumably on account of its destructive nature. It is quite common to see blow-flies hovering around broad beans infested by *Aphis rumicis*, for the purpose of feeding on the honey-dew exuded by these insects.

Aphides of the Swede, Rape, and Cabbage.

The Green Aphid (Myzus persicæ).

As mentioned above, this aphid has already been described in this series. It is very common on young plants of swede, rape, and cabbage early in the spring. As the plants become older infestation by this aphid seems to become less. The insect appears to cause but little permanent damage, but infested plants must be retarded somewhat in growth. Infestation by *M. persicae* on brassicas is a source of supply of this aphid to neighbouring potato-fields in the spring, and this is worth noting because of the importance of this insect as a transmitter of potato virus diseases. It has been demonstrated that in New Zealand *M. persicae* regularly passes the winter in the summer form on brassicas such as rape and swedes.

The Mealy Aphid (Brevicoryne brassicæ).

The wingless viviparous female is greyish-green in colour, and is thickly covered with a white mealy powder. The length of the body is approximately 2 mm. and the antennæ are shorter than the body.

The winged viviparous female has the head and thorax black or almost so. The abdomen is green with several dark markings; the antennæ are almost as long as the body; the length of the insect is approximately 2 mm.

Hosts in New Zealand.

Cruciferous crops generally—*e.g.*, rape, turnips, cabbage, Brussels sprouts, cauliflower, wild mustard, shepherd's purse, and watercress.

Observations.

This aphid is frequently the cause of severe damage to brassica crops—*e.g.*, swedes—injuring both the leaf and the seed-stalk. The distribution of this pest is world-wide, apparently occurring in all countries where brassicas are grown. The aphid feeds both on the upper and lower surfaces of the leaves, and is very abundant on flower-stems and even on seed-pods. The colonies at first are very small and cause curled-up portions on the leaves, and these act as shelters for the developing colonies. The aphid first appears in noticeable numbers on scattered and widely separated plants about January, or perhaps even as late as February. At this time the few infested plants can be easily picked out as being covered with the insects, while surrounding plants are apparently clean. In a few weeks, however, during a favourable season, the colonies have spread to neighbouring plants, and it is not long before such plants are a wilting mass giving off a characteristic unpleasant odour.

It is generally understood that a long dry season is favourable to the pest. The greatest infestation will generally, however, be found in sheltered hollows, where there is usually a more humid atmosphere, and these places act as centres of distribution. One can usually pick badly infested spots on account of their "heavier" atmospheres.

In New Zealand during the winter this aphid lives in the normal summer stages on winter greens, though, of course, reproduction is very greatly retarded by the lower temperatures. When spring arrives winged aphides are produced, and these fly away to start colonies on new crops. In countries with very cold climates the aphid lays winter eggs on winter crucifers, the cold season being passed in this way.

B. brassicae is much parasitized by various hymenoptera, the brown, swollen, and dried parasitized aphides being numerous in every colony. The insects are also attacked by the larvæ of hover flies, and also by aphis lions. The 11-spotted red and black ladybird *Coccinella 11-punctata* is very common in *B. brassicae* colonies, and must do a great deal of good in destroying many of the aphides. Entomogenous fungi are also useful in this respect. In New Zealand, however, up to the present time, natural control has not been effective enough in reducing the pest.

The False Mealy Aphid (Aphis pseudobrassicæ).

The body of the wingless viviparous female is usually a light-greenish colour with the head somewhat dusky. The body generally is dull and very lightly covered with a powdery substance, except for a series of shining areas along the back. The antennæ are about half the length of the body. The length of the insect is approximately 2 mm.

The head and thorax of the winged viviparous female are black, while the abdomen is pale green with several black markings. The antennæ are shorter than the body, which is approximately 1·5 mm. long.

HOSTS IN NEW ZEALAND.

So far collected from cruciferous weeds only.

OBSERVATIONS.

This aphid is similar to *Brevicoryne brassicae*, but can be separated at once by the characters of the cornicles and cauda. (For explanation of terms see No. 2 of this series in this *Journal* for May, 1935.) It would seem that this species is not common enough in the Dominion to cause serious injury to plants, and from the economic aspect is worthy of little comment. The life-history in New Zealand has not been followed.

The Strawberry Aphid (Capitophorus fragariæ.)

The head of the wingless viviparous female is somewhat dirty white in colour, while the body is almost the same faintly tinged with green. The insect is from 1 mm. to 1·5 mm. long, with the antennæ as long as the body. Knobbed hairs are present on the head and body.

The head of the winged viviparous female is dark brown, the thorax being green with dark brown markings. The abdomen is

pale green with dusky markings. The antennæ are approximately as long as the body, which measures approximately 2 mm. There are a few knobbed hairs on the body and head.

HOST IN NEW ZEALAND.

The strawberry is the only known host.

OBSERVATIONS.

This insect occurs very commonly on the undersides of strawberry leaves, often in great numbers, the aphides appearing to be closely appressed to the leaf. The low habit of the host plant, with the leaves close to the ground, probably provides very favourable conditions for rapid multiplication of aphid colonies, since most species appear to favour such sheltered places. The aphid passes the winter in the normal summer form on such strawberry foliage that is on the plants during the winter season, though, of course, reproduction takes place slowly during cold weather. Chamberlain of this Station and A. M. Massee of East Malling Research Station, England, have demonstrated that this aphid is a carrier of strawberry-virus degeneration disease from infected to healthy plants. This virus disease is capable of reducing the yield of berries very greatly in a few years. Apart from any mechanical injury caused by the sucking-out of the sap and so producing dwarfed and unthrifty plants, this aphid now therefore assumes a new significance, and if good crops are to be secured then it is imperative that this insect be destroyed. For Chamberlain's paper on strawberry-virus transmission, see this *Journal* for October, 1934 (Vol. 49), p. 226.

The Pumpkin and Melon Aphid (Aphis gossypii).

The wingless viviparous female is yellow to green in colour; its antennæ are about half the length of the body and are light in colour for the greater part of their length. The length of the insect is approximately 1·5 mm. to 1·9 mm.

The winged viviparous female has the head and thorax black. The abdomen varies from yellow to green with several dark markings. The antennæ are shorter than the body, which is approximately 1·2 mm. to 1·9 mm. long.

HOSTS IN NEW ZEALAND.

The writer has records from pumpkin only.

OBSERVATIONS.

This aphid is quite common on pumpkin in New Zealand, sometimes curling the young leaves. In other countries it has been found infesting melon, cucumber, and cotton, and is commonly called the melon aphid, or the cotton aphid. It is a world-wide species. Evidently this aphid overwinters in the summer stages on suitable winter hosts. It has been stated that winter eggs of this aphid have been found, but it seems to be uncertain whether it is normal for the aphid to overwinter in the egg stage.

The Primrose Aphid (Myzus primulæ).

The wingless viviparous female has the head and body of yellowish-green. The antennæ are light in colour and approximately as long as the body, which is from 2·2 mm. to 2·5 mm.

The head and thorax of the winged viviparous female are brown, while the abdomen is green to pale yellowish-green with several dark transverse markings. The antennæ are approximately as long as the body, which is about 2·5 mm.

HOSTS IN NEW ZEALAND.

Primroses.

OBSERVATIONS.

This aphid is quite common on the undersides of the leaves of the primrose. It is quite a good-sized species, but is often overlooked on account of its colouring resembling the leaf so closely. The life-cycle in New Zealand has not been followed.

CONTROL.

It is to be understood that aphides always increase at a much greater rate on plants in sheltered positions than on those in exposed situations. So that if it is possible to choose between these two types of location for plants, other things being equal, then avoid the more sheltered one. For example, swedes grown in a protected hollow will be far more likely to be attacked by aphides than will a crop growing on an exposed hillside. This may be worth considering when deciding on a suitable location for the crop. The influence of shelter on aphid population seems to apply to all species. The strawberry and primrose, with their leaves close to the ground, are plants that provide excellent cover for these insects.

For the control of the strawberry aphid where it is bad, the following operations are worthy of serious consideration. In the autumn when the fruiting-season is over, and in districts where the beds are down for two seasons or more, all leaves should be cut off the plants with a scythe, care being taken not to injure the crowns. Over the beds there will usually be a light covering of straw which has been used earlier in the season to prevent the berries from coming into contact with the soil. This straw, together with the cut-off leaves, should be teased up with a pitchfork and the whole fired from one side on a day when a good cross-wind is blowing so that the fire will traverse the whole bed quickly. Provided there is only a light covering of rubbish over the beds, the fire will sweep swiftly across and no damage will be done to the crowns. At the same time, all aphides will be destroyed. The only alternative to this operation is to cut off all leaves, rake them off the beds into heaps, and burn them at once. If the infestation has been very bad it may be necessary to spray the denuded crowns with nicotine sulphate—1 part to 800 parts of water plus soft soap from 3 lb. to 4 lb. per 100 gallons of spray. These operations are advised for the purpose of destroying overwintering aphides, since these insects cannot, of course, carry over to the next spring if there are no leaves for them to feed on during the winter. It is a good practice to spray with nicotine sulphate of the above strength when the young leaves are beginning to grow in the early spring. If the infestation becomes bad during the summer, spray when necessary with nicotine sulphate and soap. Infested runners, after they have been planted out and become rooted,

should be given a treatment with this spray. Another way of treating runners to free them from aphides is the hot-water method. Before being planted out the runners are immersed in hot water at a uniform temperature of 110° F. for twenty minutes. The runners should be placed loosely in the bath to allow even penetration of the heat. Only vigorous and strongly rooted plants should be treated. Treatment should be carried out only when immediate planting can be done. It is very important to keep the temperature of the bath constant at 110° F.; if this temperature is exceeded injury might result to the plants, and if it is not attained the results are not satisfactory.

For the control of the other aphides in small areas, spray with the above strength of nicotine sulphate plus soap. It is wise to be on the watch for these insects and to spray when they first appear. This is very important, particularly with the mealy swede-aphid, *Brevicoryne brassicae*, as the first few colonies can be killed comparatively easily, but later on, when infestation has become general, control is much more difficult. With aphides such as the mealy swede-aphid and the black bean-aphid, which cluster thickly on infested stems, it is usually necessary in bad cases to spray twice with nicotine sulphate plus soap at an interval of from seven to ten days.

ACKNOWLEDGMENT.

The writer wishes to thank Mr. W. K. Dallas of this Station for certain of the material embodied in the above paper.

LEMON MANURIAL EXPERIMENT AT TAURANGA.

INTERIM SUMMARY OF RESULTS COVERING FIRST FOUR YEARS OF EXPERIMENT.

W. K. DALLAS, Citriculturist.

A SERIES of manurial experimental plots were laid down on the 26th September, 1930, in the orchard of Messrs. Mayfield Bros., Bethlehem, Tauranga.

The object of the experiment was to determine the effect of the following treatments upon yield, quality of fruit, and tree growth—(1) Superphosphate; (2) superphosphate and sulphate of ammonia; (3) superphosphate, sulphate of ammonia, and potash; (4) superphosphate and potash—these treatments being compared with no manure. Each plot consisted of four trees surrounded by a buffer row, six replications of plots forming a series of randomized blocks.

The variety of trees chosen for the test was "Lisbon" on "Sweet Orange" stock. The trees were planted in the orchard in 1914 (being then two years from the bud), 20 ft. apart on the square. The soil was of a light pumice type, and the area flat except where the land falls away to a depression on the north-east side.

Fertilizers applied.—The following are the quantities of fertilizers which have been applied annually since the commencement of the experiment on the 26th September, 1930 (amounts of fertilizer in

hundredweights per acre) : (1) No manure ; (2) superphosphate, 6 cwt. ; (3) superphosphate, 6 cwt., and sulphate of ammonia, 6 cwt. ; (4) superphosphate, 6 cwt., sulphate of ammonia, 6 cwt., and sulphate of potash, 4 cwt. ; (5) superphosphate, 6 cwt., and sulphate of potash, 4 cwt. The dressings of superphosphate, superphosphate and potash, and potash were divided, half—*i.e.*, 3 cwt. per acre—being applied about September prior to the green crop being ploughed under, and the remainder about March, when the green crop was sown. The application of nitrogen was also divided, one dressing of 3 cwt. per acre being applied in September, and the remainder early in December.

In 1933 it was decided to apply carbonate of lime to those plots receiving sulphate of ammonia, and for every 1 lb. of the latter which had been applied 1½ lb. of lime was given to the appropriate plots. Subsequent applications of sulphate of ammonia have been accompanied by lime dressings at the same rate. This course was taken in order to correct any increase in soil acidity caused by sulphate-of-ammonia applications.

Range of Distribution of Fertilizer Applications.—The fertilizers were distributed evenly over the whole area within the trunk line of buffer trees, with the exception of an area (having a radius of 4 ft.) around each "plot" and "buffer" tree.

Green Manures.—Prior to commencement white lupins had been sown each autumn and disked under in the spring. On the 17th March, 1931, blue lupins were sown at the rate of 2 bushels per acre. Much of the crop where trees were very close became affected with *Ascochyta pisi* and died. The balance of the crop which had made growth was cut up with the disks and very well covered. In the autumn, 1932, oats were sown, and, at the time of ploughing under in the spring had reached a height of 24 in. In 1933 and 1934 no cover-crop was sown, but there was a medium to heavy crop of weeds which was disked under at each spring cultivation.

Crop Yields.—The following table shows the average production per tree and relative yields (no manure = 100) for each treatment for the four twelve-monthly periods since the commencement of the experiments, and also the total production to date.

Average Yield of Uncured Fruit per Tree in Pounds and Relative Production (No Manure = 100).

Period.	Treatments.				
	No Manure.	Super.	Super and Sulphate of Ammonia.	Super, Sulphate of Ammonia, and Potash.	Super and Potash.
15th January, 1931, to 14th November, 1931	145·7 (100)	156·3 (107·3)	212·8 (146·1)	179·8 (123·4)	183·1 (125·7)
14th November, 1931, to 2nd December, 1932	285·8 (100)	326·5 (114·2)	330·6 (115·7)	355·7 (124·5)	344·5 (120·5)
2nd December, 1932, to 15th December, 1933	121·4 (100)	170·9 (140·8)	164·1 (135·2)	200·8 (165·4)	185·2 (152·6)
15th December, 1933, to 18th December, 1934	94·5 (100)	140·2 (148·4)	187·9 (198·8)	197·5 (209·0)	143·1 (151·4)
Total	647·4 (100)	793·9 (122·6)	895·4 (138·3)	933·8 (144·2)	855·9 (132·2)

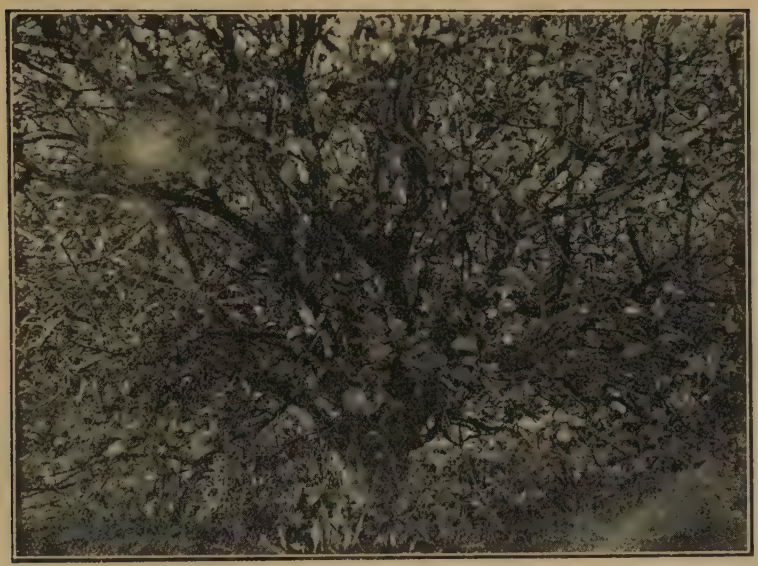

FIG. 1.

Tree in "no manure" plot. Spareness of foliage on this tree as compared with the tree in fig. 2 was typical of that occurring in the "no nitrogen" plots following frosts early in the winter of 1934.

FIG. 2.

Tree on superphosphate plus sulphate of ammonia plot. The condition of this tree was typical of plots receiving nitrogen. Photographs were taken on 24th September, 1934.

The differences recorded during the first three-yearly periods were not statistically significant,* but in the last period (15th December, 1933, to 18th December, 1934) the treatments which included sulphate of ammonia gave significantly higher yields than other treatments. In the winter of 1934 the whole block was affected by frosts, the fruit and young growth being damaged. Prior to the frosts, the trees which had received nitrogen had made much better growth than those without nitrogen, and appeared to be less seriously injured. It seems, therefore, that the differences in yield in the last period may have been accentuated by frost injury.

Curing Data.—The following summary shows curing data since the 9th March, 1931 :—

Weight of Cured Fruit as Percentage of Uncured, Grading, &c., for each Treatment for Period 9th March, 1931, to 6th November, 1934.

Treatments.	Cured Fruit as Percentage of Uncured.*	Percentages of Cured Fruit in various Grades.†			Rejects: Average Number of Fruit per 100 lb. of Uncured Fruit.
		First.	Second.	Third and Fourth.	
(1) No manure	80·2	37·6	43·0	19·4	37·5
(2) Superphosphate	82·2	35·9	43·2	20·9	33·4
(3) Superphosphate and sulphate of ammonia	81·5	38·9	41·9	19·2	36·0
(4) Superphosphate, sulphate of ammonia, and potash	80·1	35·6	43·3	21·1	37·2
(5) Superphosphate and potash ..	79·7	33·5	40·6	25·9	39·3

* Includes green, silver, coloured, and tree ripe. † Includes green, silver, and coloured.

The curing data do not suggest any appreciable differences in quality resulting from the various treatments.

Trunk-circumferences.—The following schedule shows the average trunk-circumference of trees in each treatment in each year, and the average increase in girth recorded in 1934 as compared with 1931 :—

Treatment.	Average Trunk Circumference, (Inches.)				Average Increase, 1934 over 1931.
	1931.	1932.	1933.	1934.	
(1) No manure	25·8	26·8	28·1	29·1	3·3
(2) Superphosphate	26·1	27·0	28·2	29·4	3·3
(3) Superphosphate and sulphate of ammonia	25·7	26·8	28·1	29·1	3·4
(4) Superphosphate, sulphate of ammonia, and potash	26·4	27·2	28·4	29·7	3·3
(5) Superphosphate and potash ..	25·4	26·8	28·2	29·4	4·0

Present Condition of Plots.—The trees of the "no manure" plots are obviously poorer in condition—size, density, colour of foliage, and debilitated lateral growth—than the balance of the plots comprising

* "Statistically significant" means that the chances in favour of the differences being due to manurial treatment and not to chance variation are greater than 30 to 1.

the experiment. Many of the trees in treatments 2 and 5 (which have not received sulphate of ammonia) are slightly better in condition than the trees in the "no manure" plots, but are all inferior to the average of the trees in plots 3 and 4. The difference between the trees in figs. 1 and 2 is typical of the effect obtained on the plots not receiving nitrogen (treatments 1, 2, and 5) as compared with those receiving nitrogen (treatments 3 and 4). During the latter part of the year 1934 it became obvious that the condition of the whole of the experimental block had depreciated since the experiment was laid down, mainly due to bark-blotch, citrus red scale, drought, and frost.

ACKNOWLEDGMENTS.

The assistance received from the undermentioned is acknowledged with thanks: Crop Experimentalists, Messrs. A. W. Hudson and J. W. Woodcock, in connection with the planning of the experiment and analysis of data; Messrs. L. M. Estcourt and A. R. Grainger, Orchard Instructors, for supervising the work on plots and in the curing-shed; Messrs. Mayfield Bros. and Tauranga Citrus Growers' Association, Ltd., and staffs, who willingly carried out the great amount of work involved in the orchard and in the curing-store respectively; the Pacific Potash, Ltd., and Imperial Chemical Industries, Ltd., who kindly donated fertilizers; and to the Scientific and Industrial Research Department for supplying funds for other fertilizers and railages.

CONTROL MEASURES AGAINST WORMS IN SHEEP.*

DUDLEY A. GILL, District Superintendent Live-stock Division, Department of Agriculture, Wellington.

WORMS in the true stomach and intestines of sheep cause enormous losses, but a great many of the species which seriously affect sheep are ones for which there is no known medicinal treatment. A number of reputed cures for all manner of worms in sheep are being sold, and associated with these reputed cures are wonderful testimonials and guarantees; but the fact remains, nevertheless, that there is no drug or medicine known to be effective against many of the worst offenders. Treatment will be mentioned again later and the fact that many species are not amenable to dosing with medicine is only brought in now in order to stress the importance of knowing the life history of these untreatable worms. Since it is impossible to treat them effectively with medicine, we must try to control them by other means, and we cannot do that unless their life history is known to us.

The worms which cause the most serious losses are various species of round worms, occurring in the fourth stomach and in the intestines. They are called round worms because they are cylindrical in shape and to distinguish them from tape worms, or other flat worms such as the liver-fluke.

In the fourth stomach there are two common varieties—the large stomach worm, which is about ½ in. to 1 in. or more in length, of a

* Portion of a lecturette broadcast from Station 2YA.

reddish brown colour, and with a whitish streak running spirally along its body which gives it the name of "the barber's pole worm," and the small stomach worm which is very fine and small—about ½ in. long—and often overlooked unless searched for with special care, although it may be present in vast numbers. In the small intestine there occur very minute hair-like worms, called *Trichostrongyles*, which are so small as to be found only with difficulty even when thousands are present. Another variety found in the small intestine is a somewhat larger worm, greyish pink in colour and commonly with one end coiled in a spiral form. This type sometimes occurs in tangled masses which may practically fill the gut for a few inches or more. The hook-worm of sheep also occurs in the small intestine. Fortunately, it is common only in some districts, as it is rather a serious parasite. It is easily seen, being fairly stout though only about ½ in. or so in length. This worm may be seen when the gut is opened, and, in addition, its presence can be surmised easily because its attack on the lining membranes of the intestine causes numerous small red spots of hæmorrhage about the size of a pin's head. One does not find this variety in large numbers like the others.

In the cæcum or blind gut the so-called whip-worm commonly occurs. It is 2 in. or 3 in. long, has a fairly stout, white hinder-end, and attaches itself to the gut-wall by a very thin, hair-like neck—hence the resemblance to a whip. This species is often quite numerous and is easily seen, so that whip-worms often greatly impress the farmer who makes a post-mortem examination on one of his sheep, but actually they do little harm and are found in almost all sheep at some time or another. In the crown and in the hinder part of the gut two other species which may be encountered appear alike to ordinary observation. They are whitish worms about ½ in. to 1 in. long, stout, and easily seen. One of these (*Chabertia*) sometimes causes marked inflammation by biting the lining membrane, and a few of them can do a good deal of damage, since they move about from one place to another, feeding and damaging the gut-wall as they go. Usually they do not cause much loss, but in some cases may result in diarrhœa and straining, and a good deal of loss in condition. The other important worm in the hinder gut is not common in New Zealand, and does not appear to cause losses here, though it is a very serious menace in more tropical countries, where a high summer rainfall provides the conditions of heat and moisture which encourage its propagation.

These are not by any means all the worms occurring in sheep in New Zealand, and it must be understood that where one has mentioned a type such as the tiny *Trichostrongyles* in the small intestine, one refers to a number of closely related species having very similar characters.

In the life history of these worms there is one fact which it seems well to stress, because few farmers realize its significance. It is that worms do not multiply inside the animal. Every worm found inside a sheep has reached it from outside and represents a larval worm taken in by the sheep along with its feed.

Of all the worms mentioned the only ones amenable to treatment by medicines or drugs are the large stomach-worm or barber's pole worm, the hook-worm, and, by a special method which has only recently been devised and is not yet widely used, the two species mentioned as occurring in the hinder gut. None of the others can be dealt with

adequately in this way as yet, though all manner of medicines and methods have been carefully tested. Since they cannot be sufficiently overcome inside the sheep by drugs, it is well to consider how they behave outside the animal in order to discover whether it is possible to counteract them during that stage of their lives.

The female worms of any of these species lay numerous eggs, and some of them lay almost incredible numbers. It is fairly common for one female to lay several thousand eggs a day. The eggs are passed out in the fæces, and each one is a potential parasite for sheep. Possibly millions of eggs are passed every day by a badly infested sheep in whose intestine there may be, say, 100,000 female worms each laying several thousand eggs daily.

If all these eggs actually gave rise to worms in the stomach or intestines of other sheep, it would indeed be disastrous, and very few lambs would ever reach their full growth. Fortunately other factors come into play. Sheep are not parasitized by worm eggs until these eggs have gone through stages of development outside the body, a process which takes time during which the parasites are readily destroyed by such conditions as dryness or sunshine.

While the life histories of all the worms mentioned vary in detail, they are all similar in the main essentials, so that a general outline suffices. Under suitable conditions of moisture and warmth the eggs hatch in two or three days and a larva emerges. The larva merely develops a little further and then moults or sheds its outer covering, continues to develop and moults a second time. After the second moult the larva is ready to infect another sheep. The length of time occupied in moulting varies much with the suitability of the conditions —whether it is warm enough and wet enough being the chief considerations. If conditions relative to warmth and moisture are ideal for the parasite, each of the two moults will take two or three days, and if the weather is adverse the moulting will take longer. The important point is that even under ideal conditions for the parasite an egg passed by an infected sheep cannot infect another sheep till it has hatched and gone through two moults—a process that will take at least six or seven days, and generally longer. When the larvæ are going through their first and second moults after hatching they are very readily killed by sunshine and dry conditions; but once past the moulting and at the infective larval stage, as it is called, they are much more resistant and for prolonged periods can lie in wait to be picked up by a suitable host.

This infective stage is, of course, the important one, simply because it is infective.

Weather conditions affect the larvæ in the infective stage, but in rather an indirect way. Curiously enough the infective larva does not feed, and hence the more actively it moves about the quicker it will use up its reserves of energy, and when that has happened it will die. Given suitable conditions it does move quite a lot, as nature seems to have endowed it with habits best calculated to help it find a good home inside a sheep.

If there is enough moisture—even a thin film of dew is sufficient—and mild light, the infective larvæ crawl up grass blades and stay there waiting for a grazing sheep to pick them up. Strong light drives them back to the roots of the grass and to the soil again. They will therefore

crawl up the grass blades mainly in the early morning and evening and at other times of the day in dull weather. At night, as well as in sunshine, they usually descend to the soil, and in dry conditions tend to penetrate the upper layers of soil. It will be understood readily from this that if the weather leads to the larvæ frequently travelling up and down the herbage, they will soon wear themselves out and die, and it is considered that larvæ capable of living quietly for a year or more may die in three months or less if the climatic conditions induce sufficient activity.

What practical advantage can we take of this knowledge of the life history of these parasites? In the first place it indicates the need for very careful sheep-pasture management. It is inadvisable to let sheep-pastures become too long. If pastures become long, more especially in damp localities, they provide just the shelter from sunlight and the drying effects of wind which help the parasites to survive during their more delicate stages. As far as possible it is advisable to move sheep frequently and to have sufficiently small paddocks to be able to do this. If it is possible to move sheep every week or ten days the eggs they have passed during that period will not have had time to reach the infective stage, and by the time the parasites reach the infective stage there will be no sheep present to infect. If there are swampy areas or lagoons from which the sheep drink, it is advisable either to drain them or to fence them off. Such areas, because they offer conditions suitable to the parasites, and because sheep frequent them for water, are apt to be heavily infected. Where possible it is well to let cattle graze the paddocks ahead of the sheep. There are two very sound reasons for this. In the first place the cattle eat out the longer feed, leaving more suitable grazing for the sheep which follow. Secondly, the cattle remove many infective larvæ of parasites which infect sheep: sheep-parasites, with the exception of the large stomach-worm, do not infect cattle, and such as are eaten by cattle will be destroyed. Lambs and hoggets should be allowed to graze ahead of older sheep. Most sheep have an appreciable number of parasites in their intestines, and consequently are passing eggs, but with age the animal develops resistance against the adverse effects of worms. It is the lamb and the hogget which are most affected, and hence they should always be given the first chance at a clean "break" of feed. Such eggs as lambs and hoggets pass do not harm the ewes which follow them much, but ewes that appear quite healthy may yet pass sufficient eggs to infect seriously hoggets or lambs coming after them.

That sheep acquire a resistance to parasites with age is a statement that needs a little explanation. It is not their age which gives them resistance—they have acquired the ability to resist worm-infestation through having been infested and having overcome the infestation in their earlier days. The matter has been investigated a good deal, and definite information obtained. A satisfactory indication of the number of worms harboured by a given sheep can be obtained by counting, with the aid of a microscope, the number of eggs it is passing. It is found that if a sheep known to be free of a certain species of worm is deliberately fed with infective larvæ, eggs begin to appear in its droppings after a time—usually about three weeks. These eggs increase in numbers for a time, and then quickly fall off, till very few are passed. Once a sheep has gone through such an infestation it is

difficult to reinfect it with the same species of worm. Having had experience of that particular worm the animal has somehow found ability to overcome it and to resist further attacks. But there are two very important points to note about this. Firstly, the parasite seldom is completely overcome, and usually the sheep tolerates a few —hence the almost universal finding of various species of worms in older sheep which appear in perfect health. Secondly, the resistance that the sheep has acquired is not very strong, and is easily broken down, especially by undernourishment. That is why good feeding is such a very important factor in the control of worms, not only in sheep, but in any animal. The poorly fed lambs and hoggets readily fall victims of parasites where well-fed ones may pick up just as many infective larvæ and suffer comparatively little. Lambs and hoggets are more seriously affected than older sheep, partly because, owing to their youth, they have as yet had no chance to acquire resistance and partly because food-shortage or deficiency tells more heavily on the young growing animal than on the adult. Adult sheep are by no means immune to serious worm-infestations; in fact ewes, wethers, and rams are not uncommonly lost through it, but when this happens one finds two factors responsible—poor feed conditions, and circumstances which lead to a heavy intake of infective larvæ. Such facts may suffice both to explain and to stress the enormous importance of good feed, not only for the prevention of loss from parasites, but also in the treatment of affected sheep.

Lastly, there are some points about the treatment of sheep for parasites which seem to need emphasizing.

So far as worm drenches for sheep are concerned the choice of effective and practicable drugs is very limited. Omitting such things as lysol, which is not often used for sheep and has no particular advantage, one is left with the following: (i) Copper sulphate (either by itself, or mixed with arsenic or mixed with nicotine sulphate (Black Leaf 40)); (ii) carbon tetrachloride and tetrachlorethylene.

The doses of these to use may be obtained from the local veterinarian or stock inspector. The question is which of these things to choose.

If sheep are infected by fluke or hook-worm, it is advisable to use carbon tetrachloride, which is effective, whereas copper sulphate, arsenic, and nicotine are useless. Extract of male fern is effective against fluke but is too expensive.

If tape-worms are present, a mixture of copper sulphate and nicotine sulphate (Black Leaf 40) should be used.

The usual purpose of drenching sheep, however, is the control of the large stomach-worm, to deal with which any of the drugs or mixtures mentioned may be relied on: but copper sulphate is just as effective as any of them, and it is very much cheaper.

Whereas it was always advised to starve sheep for twelve hours or so before drenching with copper sulphate, it is now known that this is quite unnecessary. The results are just as good if the sheep are brought in and dosed straight away. Such a practice is much handier for the farmer and is much less of a strain on the sheep, especially if they are already weakened by the attacks of the parasite.

It is sometimes difficult to convince a farmer that his sheep are suffering from stomach-worm if they are not scouring. The large

stomach-worm does not cause scouring, which usually is due to the smaller worms farther down the intestine. Some of these, as well as large stomach-worms, are usually present, but if the latter are present almost alone, as they sometimes are, there is generally no scouring at all. The animal merely becomes weak and very anæmic and may die if not treated in time.

Since the large stomach-worm, against which copper sulphate is effective, is usually only one of several varieties of worm infesting the sheep, it may be asked what use is served by clearing out that one and leaving all the others against which copper sulphate is practically useless. The answer to that is that if the large stomach-worms are overcome and the animal is put on better and more strengthening feed, the decrease in stomach worms and the better feeding together, generally enable the animal to fight a successful battle against the other species affecting it.

There are instances, however, where heavy losses from intestinal worms occur, and where copper sulphate is ineffective because the large stomach-worm is not involved, and the worms responsible are not amenable to that treatment. It is in such cases that good feeding and proper management in the light of the information given herein concerning the life history of such worms play so large a part in their control.

As has been said, the small stomach-worm and most of the intestinal worms of sheep have resisted all methods of treatment with drugs. Recently, however, there has been some grounds for hope that a solution of the difficulty may be within sight. A brief explanation of this should prove of interest.

The effectiveness of copper sulphate, and the ability to dispense with starving the sheep before giving it, are due largely to the fact that this drench almost always passes straight into the abomasum or true stomach, whereas most other worm-medicines are apt to pass into the rumen or paunch. This was first observed by Dr. Clunies Ross, a well-known veterinary parasitologist in Australia, and it may well have far-reaching effects, as it offers a new line of attack against the species which so far have resisted treatment.

One of the main difficulties in treating such cases has been that the drugs used could not be brought within striking distance, as it were, of the worms. It may now be possible, by combining suitable drugs with copper sulphate, to convey them straight into the abomasum and thus avoid their being side-tracked in the rumen. There are already some observations, recorded by Dr. Clunies Ross and his colleagues, that a combination of copper sulphate and nicotine sulphate (Black Leaf 40) has a distinct effect on *Trichostrongyles* in the small intestines of sheep—parasites which have been regarded previously as being among the most difficult to deal with.

Much further work is needed before it can be stated confidently that a reliable method of treatment has been found, but research on these lines is being pushed on with in institutions specially equipped for such purposes, and it can be said that the position to-day is more hopeful than it has ever been in the past.

THE IDENTIFICATION AND PURCHASE OF CERTIFIED SEED POTATOES.

MOST potato-growers are aware of the differences between Government certified seed potatoes and uncertified seed potatoes, and the benefits that are to be derived from the use of the former when planting their crops. From information obtained from time to time by the officers of the Department of Agriculture, however, it would appear that many purchasers of seed potatoes are not aware of the means of identification of Government certified seed. It is the intention of this statement to draw the attention of purchasers to the ways in which they may be sure of receiving the genuine article.

Firstly, then, the certification of seed potatoes may be divided into two stages. The former commences with the entry of the grower's crop into certification at or before the time he actually plants his crop. It continues through the growing period, and includes the field inspection of the crop when in full growth to determine the percentage of foreign varieties and virus-diseased plants which may be present. This stage concludes before the crop is dug, and upon the inspections made and information gained certain crops are rejected, while others are classed into "Mother" or "Commercial" according to quality, and further sub-classed into numbered groups. This classing of crops is known as "Provisional Certification."

To the growers of all crops accepted at this stage publicity in the Department's *Journal* is given, and provisional certificates are issued indicating that the crop "has been found to be sufficiently vigorous and free from foreign varieties to warrant the issue of this provisional certificate." This certificate further states, "This is not a final certificate, and the grower is not entitled to sell his seed as certified seed until such time as his graded produce has been inspected . . . ."

A provisionally certified crop, therefore, is one which has reached the standards in regard to the inspection of the growing plants but the produce from which has not yet been inspected to determine the standard of freedom from diseased and damaged tubers, grading according to size, &c.

The second stage in potato-certification covers the inspection of the produce harvested from a provisionally certified crop to see that the tubers comply with the standards set in regard to freedom from diseased and damaged tubers, grade, &c., and the issue of tags to attach to the sacks of any produce which complies with these standards. Thus, when a grower of a provisionally certified crop has a portion or the whole of his produce graded and in sacks ready for sale, he communicates with the local Instructor in Agriculture. The Instructor inspects the produce, and, if it complies with the standards set, prepares and signs sufficient tags to attach one to each sack passed, and issues them to the grower. The grower attaches a tag to each sack passed, countersigning it to the effect that he guarantees the contents of the sack to be tubers harvested from his provisionally certified crop, and to have been passed by the Instructor as indicated on the reverse side of the tag. This completes the final certification of a particular line of potatoes, but covers only the produce inspected at that stage, and does not include produce which is later to be graded and sorted.

The two stages may be summarized as follows :—

(1) Provisional certification, which covers the field inspection of the crop.

(2) Final certification, which covers the tuber inspection of the produce of a provisionally certified crop.

While a grower is perfectly entitled to sell his produce at the provisionally certified stage, and is not compelled to have it finally certified, there is no way of identifying provisionally certified seed other than by taking the word of the vendor.

Every sack of finally certified seed, on the other hand, has attached to it a certification tag signed by the Instructor and countersigned by the grower. This is the purchaser's official identification mark for certified seed, and any purchaser stipulating certified seed who receives seed without a tag attached to each sack is entitled to refuse acceptance of such seed on the ground that it is not finally certified. Tags are occasionally lost in transit, of course, but any line which has not a certification label attached to every sack should be accepted reservedly, while a line with only a few sacks tagged should not be accepted as certified seed under any conditions.

The purchasers of small lines of less than a sack of seed potatoes are in a less fortunate position in regard to the identification of the material they are purchasing. At least, they have been in that position, but the Department of Agriculture is now prepared, subject to certain conditions, to finally certify potatoes packed in crates containing 14 lb., 28 lb., or 56 lb. of tubers. Such crates are of standard pattern, bearing a special certification sticker on one end, and sealed with string and a certification seal in such a manner that the crate cannot be opened without breaking the string. Thus purchasers of small lots have it in their own hands to be sure of obtaining certified seed potatoes. At the present time the supply of crated potatoes is not great, and difficulty may be experienced in obtaining them. The supply, however, is limited only by the demand, and as the demand increases so will vendors find it worth their while to stock crates of certified seed.

—J. H. Claridge, Certification Officer.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 11th July, 1935, to 25th July, 1935, include the following of agricultural interest :—

No. 72861 : Shearing-machine-comb cleaner ; E. H. Smith. No. 73964 : Tine-harrow unit ; R. M. Wilson. No. 73388 : Teat-cup ; A. W. Stewart. No. 73470 : Harrow ; H. V. McKay Massey Harris Pty., Ltd. No. 74007 : Incubator ; R. Harrison. No. 74039 : Plough-wheel centre ; A. C. Anderson. No. 74040 : Agricultural implement ; A. C. Anderson. No. 74110 : Honey-cappings melter ; J. F. G. Roberts. No. 74111 : Melting and reconditioning honey ; J. F. G. Roberts.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s., prepaid.

Erratum.

The titles to the illustrations on page 35 of the July *Journal* were transposed.

THE WHITE BUTTERFLY MENACE.

EFFICIENT CONTROL BY THE PUPAL PARASITE, *PTEROMALUS PUPARUM*.

J. MUGGERIDGE, Entomologist, Plant Research Station, Palmerston North.

IT is known generally that the white butterfly first made its appearance in Hawke's Bay in 1930 and by 1933 was to be seen in millions flying over the road-sides and pastures, and as a white fluttering cloud over every cruciferous crop in and around Hastings.

In 1933 the first pupal parasites (see this *Journal*, September, 1933) were liberated and the following account of their activities augurs well for the future control of the pest.

In 1933 10,812 parasites were liberated at Maraekakaho, Hawke's Bay, and in a subsequent examination of 415 butterfly pupæ collected there, 58 per cent. were found to be parasitized; this not only ensured their destruction, but indicated the probability of an increase in the parasite.

In 1934 there was a noticeable reduction in butterflies around Maraekakaho, but elsewhere they increased and spread; therefore additional parasites were liberated in this centre. Later in the same year, 90 per cent. of 5,000 butterfly pupæ collected much farther afield than the original place of liberation proved to be parasitized, and the parasite had then spread over hundreds of square miles, extending as far as Alfredton, a distance of eighty-two miles.

During the past season—*i.e.*, 1934–35—the pest virtually was brought under control in Hawke's Bay, and pupæ, which were very difficult to find, were heavily parasitized.

Parallel events have occurred in the Manawatu—a small supply of parasites having been liberated in 1934 resulted in 14 per cent. of the pupæ collected being parasitized. At points outside of where the parasites were liberated 19,567 pupæ were collected, and none of these was parasitized.

During 1934–35, butterflies were very prevalent in the Manawatu–Marton district, but the parasites already liberated were equal to the occasion, and of 21,881 butterfly pupæ collected this past winter of 1935, no less than 20,940, or 96 per cent., were found to be parasitized.

No doubt the white butterfly will always be with us, but the parasite has checked effectively the widespread ruin that inevitably would have occurred in the most important of our forage crops—the brassicas.

CERTIFICATION OF SEED POTATOES.

CROPS PASSED TUBER INSPECTION DURING JULY, 1935.

APPENDED is a list of growers whose crops have been subject to and have passed the tuber inspection in connection with the system of Government certification of seed potatoes conducted by the Department of Agriculture. The list supplements that published in the July *Journal*, and refers to those crops passed during July. Further tests will be published in later issues.

In the May *Journal* was published a list of growers who have received provisional certificates. The acreage, percentage of foreign varieties present, and the classification and group number representing the relative merits of lines were given in the list, to which intending purchasers should refer.

Aucklander Short Top.

Mother Seed—
Amor, A. W., Woodend (Line A).
Amor, A. W., Woodend (Line B).
Amor, A. W., Woodend (Line C).
Anderson's Estate, Lincoln (Line B).
Anderson's Estate, Lincoln (Line C).
Crump, F., Springston, R.M.D. (Line A).
Dyer, H., Southbrook.
Eder, W., Sefton, R.M.D. (Line A).
Ferguson, J. W., R.M.D., Winchmore.
Franks, L. J., 88 Russley Road, Christchurch.
Guy, T. A. and E. B., Yaldhurst.
Jellie, J., Russley Road, Upper Riccarton, Christchurch.
Johnston, R. H., Dunsandel.
Kavanagh, D., 50 Ryan's Road, Upper Riccarton, Christchurch.
Marshall, D., Killinchy - Leeston, R.M.D.
Martin, W. E., Kaiapoi, R.M.D. (Line A).
Mulcock, W. J., Ryan's Road, Upper Riccarton, Christchurch.
Nicklaus, J. F., 104 Ryan's Road, Upper Fendalton, Christchurch.
Prebble, R. L., Springston, R.M.D.
Prosser, L. W., Leeston, R.M.D.
Rathgen, A. E., Killinchy - Leeston, R.M.D.
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch.
Rolston, G., Weedon's - Greendale, R.M.D.
Roper, P. F., Halkett, R.M.D.
Seaton Bros., Courtenay, R.M.D.
Smith, E. A., Springston, R.M.D. (Line B).
Stewart, A., Marsh's Road, Templeton.
Swanson, W., Selwyn.
Ward, C. R. T., Ladbrook's.
Weeber, H., Englefield Road, Belfast (Line A).
Wilson Bros., Halkett, R.M.D. (Line A).
Wilson Bros., Halkett, R.M.D. (Line B).
Wilson, M., Halkett, R.M.D.
Wilson, W. A., Halkett, R.M.D.
Wolff, R. G., Horrelville, R.M.D.
Wright, Q. A., Annat.

Commercial Seed—
Ballantyne, C. T., Gleniti, Timaru.
Couper, R. P., Washdyke, Timaru.
Eder, W., Sefton, R.M.D. (Line B).
Gaffeney, Mrs. M. F., Arowhenua, Temuka.
Gray, R., St. Andrews (Line B).
Hastie, A. W., Pareora, Timaru.
Musson, W. R., Rangiora.
Oliver, J. O. J., Factory Road, Temuka (Line A).

Aucklander Short Top—*continued.*

Commercial Seed—continued.
Oliver, Mrs. Z. M., Temuka.
Proudlock, A., East Eyreton - Kaiapoi, R.M.D. (Line B).
Reynolds, H., Watson's Road, Harewood.
Saunders, W., Clandeboye, Temuka.
Smith, R. S., "Beach Farm," St. Andrews.
Topham, J. W., Arowhenua, Temuka.
Traves, H., Levels, South Canterbury.

Dakota.

Mother Seed—
Burrowes, J., Chertsey, Mid-Canterbury (Line A).
Chambers, R., Rolleston.
Crozier, W. J., Mount Hutt, R.M.D., Rakaia (Line A).
Crozier, W. J., Mount Hutt, R.M.D., Rakaia (Line B).
Gardiner, O. J., Dunsandel.
Hooper, R. M., Mitcham, via Rakaia (Line A).
McPhail, W. A., Mitcham, via Rakaia (Line A).
Steele, J., Kimberley, R.M.D. (Line A).
Walker, C. E., Estate of, West Melton, R.M.D.
Williams, J. W., Halswell.
Wilson, M., Halkett, R.M.D. (Line B).

Commercial Seed—
Steele, J., Kimberley, R.M.D. (Line B).

Arran Chief.

Mother Seed—
Batchelor, R. S., Waimate.
Bennett, J., jun., Papatotara, R.M.D.
Boyce, W. J., Waituna, Waimate.
Daly, P. G., Te Waewae.
Griffin, J. G., Te Waewae.
Knowler, H., Te Waewae.
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch (Line B).
Saunders, E. E., Studholme Junction (Line B).
Smith, W. J. M., Seadown, Timaru.
Teschner, C. A., Knapdale, R.M.D., Gore.

Commercial Seed—
Beckingsale, J. H., Clearview Settlement, Herbert.
McCarthy, E., Prebbleton (Line A).

Arran Banner.

Mother Seed—
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch.
Sheddan, G. B., Otahuti, R.M.D. (Line A).
Wilson, C. H., Lorneville, Invercargill.

ARRAN BANNER—*continued.*

Commercial Seed—
Harvey, W., Mosgiel.
Robinson, D. B., Waikuku.
Sheddan, G. B., Otahuti, R.M.D. (Line B).
Smith, C. R., Bushy, R.M.D., Palmerston South.

KIND EDWARD.

Mother Seed—
Griffin, J. G., Te Waewae.
Mehrtens, L. C., Box 27, Tuatapere.

Commercial Seed—
Kenny, J., Mosgiel.
Marshall, W., and Sons, Outram (Line A).
Marshall, W., and Sons, Outram (Line B).

AUCKLANDER TALL TOP.

Mother Seed—
Court, R. T., R.M.D., Swannanoa (Line A).
Eder, W., Sefton, R.M.D.
Guy, T. A. and E. B., Yaldhurst.
Steele, F., Fernside, Rangiora (Line A).
Steele, F., Fernside, Rangiora (Line B).
Steele, F., Fernside, Rangiora (Line C).

AUCKLANDER TALL TOP—*continued.*

Commercial Seed—
Court, R. T., Swannanoa, R.M.D. (Line C).

EARLY ROSE.

Mother Seed—
Burns, R. A. C., Te Pirita, R.M.D., Rakaia.

EPICURE.

Mother Seed—
Burgess, D., West Plains, Invercargill.
Robinson, R. G., Ltd., Box 4, Papanui, Christchurch.
Wright, L. T., Annat.

JERSEY BENNES.

Mother Seed—
Penn, T. A., 154 Innes Road, Christchurch (Line A).

EARLY REGENT BOLTER.

Mother Seed—
Pascoe, S., Halkett, R.M.D.

—Fields Division.

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SEASONAL NOTES.

THE FARM.

The Coming Month.

As a rule, September is an embarrassingly busy month for the efficient farmer. Indeed, farmers who are not desirous of doing more work in September than they can hope to accomplish with convenience are probably either very fortunate in being well ahead with their farm operations or remiss in respect to some jobs that profitably would repay attention. Many successful farmers follow three rules in regard to September work: Firstly, they make use of every hour in which it is practicable to work; secondly, despite their eagerness to make seasonable progress, they carefully abstain from doing any class of work which would be better undone because of wet conditions; and, thirdly, when faced with a greater amount of work than can be carried out at once with the labour available they exercise sound judgment in discriminating between tasks which can be deferred without serious consequences and tasks which in the interests of a reasonable standard of efficiency must receive attention without delay. Indeed, reliable evidence of good management is deciding what jobs are essential at a particular time, doing them at that time and leaving undone for the present other jobs which must be done later but which do not call so urgently for attention. Though this may seem an obvious simple fact it is disregarded so much in practice that one of the greatest causes of waste in farming is expenditure of labour and material on work carried out at an unsuitable time. The condition of the seed-bed and the sowing date, which are important factors in success with crops, are dependent to a large extent on the time at which preparatory cultivation is carried out, and it is chiefly because of this that September field-work is of such great moment.

Management of Spring-sown Crops.

Valuable guidance relative to the management of spring-sown crops is provided in the following statement in which Russell, of Rothamsted, summarizes the available knowledge:—

"Most spring-sown crops take up practically all the nitrogen, phosphate, and potash that they need within the first five or six weeks of growth; material taken up later is of much less value and may even be harmful." New Zealand trials and general field experience accord fully with this.

One of the deductions from the statement is that the seed-bed is of basic importance and calls for preparatory cultivation, ample and early enough to give the maximum supply of readily available plant-food material, a result which is obtained most economically by the weathering processes which appropriate cultivation facilitates. Over many years extensive examination of crop results shows that constant cultivation is the essential basis of fully satisfactory results from manures, seeds, and land.

Another deduction from the fact that certain crops take most of their food from the soil while quite young is that any fertilizer supplied should be such that the crop can use it readily. This, generally, may be secured not only by supplying substances which are readily available, such as superphosphate, but also by supplying them in a place readily accessible to the crop. This means that it must be in the vicinity of the youthful root-system of the crop. Hence, provided seedling-injury is avoided, placing artificial fertilizer in the drills should be more effective than broadcasting it all over the soil, and trials show that as a rule this is the case. As phosphatic fertilizers normally are of greatest importance in New Zealand cropping it is of moment

that while the young crops need their phosphate right from the start there is variation in the ease with which they can obtain the phosphorus from relatively insoluble compounds. According to overseas investigations, swedes, turnips, and lucerne have greater ability than cereals and potatoes to obtain phosphorus from relatively insoluble phosphates. This is in accordance with New Zealand experience and assists in explaining, for instance, the satisfactory results that have been obtained in Southland from root-crop manures which contained considerable amounts of insoluble phosphates the assimilation of which is favoured by plentiful supplies of moisture. In dry regions in which similarly good results are not given by the insoluble phosphates field trials point to the advisability of using quickly-acting phosphates with turnips, provided suitable precautions are taken to avoid injury of seedlings by contact with soluble fertilizing material.

Even though turnips and lucerne are better able than other spring-sown crops to obtain phosphorus from relatively insoluble phosphates it does not follow that such phosphates should be the exclusive phosphatic constituent of manures for turnips and lucerne, which consistently benefit distinctly from the immediate stimulation of growth which results from the use of superphosphate, possibly in conjunction with more slowly acting phosphates. To sum up, the young plants of spring-sown crops need phosphate right from the start, and this calls for the use of at least some superphosphate, and, as a rule, the use of superphosphate to the exclusion of other phosphates is followed by quite satisfactory results.

A particularly high standard of fertility is reflected profitably in the yields of crops capable of such heavy production as the mangel and chou moellier. As a result, it often proves well worth while to supplement the liberal use of artificial fertilizers by dressings of animal-manure from stock yards, &c., or of decayed crop remains, such as are provided by stack bottoms—such dressings should be scattered as uniformly as possible in good time to allow of their becoming well incorporated in the soil by the time the young crop is exploring the soil for food material.

Special Crops for Winter Use.

One of the major objectives of spring field-work should be the provision of feed for use in the following winter. For this purpose the mangel is one of the most valuable crops except for use in the more severe southern districts. When the fertility and cultivation are both good, mangels are characterized by excellent yields ; but unless there is assurance that mangels are to receive good treatment their culture is not advisable. The position, briefly, is that good treatment of mangels ensures good results, but indifferent treatment may beget not indifferent, but poor crops. The marked and valuable reliability of mangels under good treatment is due partly to their general freedom from attacks of any serious diseases or pests and partly to their ability to withstand dry periods relatively well—their tolerance of conditions dry enough to affect injuriously some other important crops is indicated by the exceptionally heavy crops of mangels which were obtained last season in districts such as the Manawatu, which experienced an abnormally dry summer. Despite this, a Manawatu record average yield of over 80 tons an acre was obtained in respect to thirty-two crops. Occasionally mangels are attacked by a rot which persists in the soil ; the first attack usually is slight but if mangels are grown again immediately after such an attack a heavy percentage of the plants may be destroyed either in the seedling-stage or when the roots have attained a considerable size. No satisfactory means of treating an attacked crop is known.

Swedes, and, in the severer southern climates, turnips, may often suitably be used instead of mangels, and this especially on fairly extensive farms where there is any uncertainty about being able to provide the good treatment desirable for mangels. Carrots are favoured by free, fertile

soils on which, as Taranaki results have shown for years, really profitable yields can be obtained without an excessive amount of labour, especially if the Guerande variety is grown.

The popularity of chou moellier, sometimes called marrow-stem kale, rightly continues. Chou moellier calls for good ground of the class from which a good crop of cabbage reasonably could be expected. Land which naturally is not of sufficiently high fertility to give attractive crops may be made suitable by additions of animal-manure and similar materials, especially when these are supplemented by artificial fertilizers. Chou moellier proves especially valuable on good ground that is prone to be so wet at the time of feeding-off as to make it difficult to avoid waste in the use of swedes. Chou moellier is at times particularly valuable because it is markedly resistant to club-root, though it does not possess complete immunity.

Special Crops for Summer Use.

Frequently pastures yield unsatisfactory direct supplies of feed from about Christmas or New Year right through to March. Often some attempt is made to cater for the needs of the February–March portion of this period, but many farmers seem not to recognize that it is profitable to make special provision to supplement the pastures during January. Normally the summer feed directly available from pastures more often is deficient in quality rather than inadequate in quantity—frequently it is too woody or fibrous, too indigestible, and too poor in mineral matter, three faulty features which may be summed up by saying that too mature a stage of growth has been reached by the herbage. The remedy is the provision of non-woody feed. Soft turnips are of outstanding value for this purpose as they are highly digestible if not allowed to become overmature and there normally is plenty of opportunity to utilize the crop before overmaturity develops—in this they excel the other crops available. Another crop that, rightly, is widely grown for summer use is rape, which is of outstanding value for the fattening of lambs when the needs of these cannot be supplied by the pastures. In the warmer districts green maize and millet are of value for summer use provided they are utilized when in a young leafy stage.

The amount of special leafy or non-woody feed needed in summer may be lessened appreciably by keeping the pastures themselves in a leafy condition by such practices as ensilage and rotational grazing, which assist in avoiding the development of flowering stalks in pasture-plants; but in dairying, at least, grazing-management, even though it be fully efficient, frequently will not rectify completely the summer shortage of the non-woody type of feed required for heavy milk-production.

Lucerne.

A vigorous stand of lucerne is so valuable and so widely obtainable that increased attention could well be given this season to the establishment of lucerne. While profitable results with lucerne are being obtained over a wide range of conditions of soil and climate the most highly productive crops occur, as a rule, on distinctly fertile soils. The outstanding merits of lucerne well warrant allotting a fertile area to it, yet at times attempts are made to grow lucerne on areas on which it has not been found possible to grow any other crop satisfactorily. As the success which attends the establishment of lucerne depends to a considerable extent upon the initial steps, these should be based upon the latest knowledge available. Much information about lucerne-culture is provided in Bulletin 155, obtainable on application from the Department of Agriculture.

General Considerations regarding Cropping.

By planning to produce reserves of feed in excess of prospective requirements one is likely to be in a better position to face unexpected crop-failures.

It is a serious matter to be short of feed at critical periods ; and, on the other hand, a surplus of feed ordinarily never need be wasted, while it may enable exceptionally advantageous market opportunities to be grasped.

In planning the cropping programme provision should be made for the requirements not only of the main class of stock on the farm, but also of less-important classes, such as pigs and poultry on dairy-farms, and these together with cows on farms devoted dominantly to grain or sheep. The poor returns often obtained from cows, poultry, and pigs kept as side-lines frequently are due primarily to poor feeding. Judicious extension of the programme of arable cropping commonly is a very economical means of improving such poor feeding.

In the case of high-priced land, low cost of production of feed by special cropping is almost always linked with heavy yields per acre secured by really good treatment of a relatively small area. Hence on high-priced land there is special need for thorough cultivation, without which good seed and manures are likely to be wasted to some extent.

Preparatory cultivation for such crops as lucerne, mangels, and potatoes should be undertaken in September if it has not been commenced already. The potato thrives in a loose rather than in a compacted soil. When the cereal-sowing has been carried out the teams may well be kept busy on land for rape and root crops. By cultivating such land in good time one most easily secures the desirable type of seed-bed—that fine from the bottom upwards, as distinct from that consisting of a fine surface layer of soil underlain by hard lumps, which is the type of seed-bed likely to be obtained when cultivation is late and hurried.

Fields for Silage and Hay.

Pastures intended for silage or hay should be eaten off evenly and closed up as soon as they can be spared from grazing. Early closing is valuable because it increases the possibility of early mowing, which in its turn gives greater probability of a good aftermath that is generally very useful with the advent of the customary summer shortage of non-woody feed. A dressing with superphosphate at closing-up of fields for ensilage or haymaking is usually profitable if such fields have not been top-dressed recently. Wire, timber, &c., likely to cause delays or breakages in mowing should be removed carefully from fields prior to closing them up.

September is often also a suitable time to close up lucerne areas for an early cut, which is suitably saved as silage. An early cut is especially valuable when it gives a setback to plants which harmfully invade the lucerne in the winter and spring and which the lucerne is able to outgrow, and thereby suppress, when the cold conditions of winter and spring are past. A general result of early closing of lucerne and consequent conservation of the first cut as silage is an additional cut annually from the lucerne area.

Utilization of Feed.

If pastures damaged by grass-grubs are not affected so seriously as to be beyond repair, then as far as practicable the feeding-out of hay, silage, and roots should be concentrated on them. On the other hand, if the majority of the valuable plants in the pasture have been destroyed by the grubs, then the best course almost always is to put the land under the plough. In planning the cropping of such land it should be remembered that grass or cereal crops cannot with safety follow a grass or cereal crop which was attacked by the grass-grub.

The feeding of stock wholly or largely on roots, which generally is inadvisable, is especially so in August and September, and when persisted in at this time has led to disorders in stock. The roots should, if possible, be supplemented by hay or chaff.

The Pastures.

Over a wide range of conditions pastures often may be sown successfully in September. Generally the most successful establishment is obtained when the pasture is not sown with a companion crop. Permanent pastures especially should be freed from the injurious competition of companion crops. When companion crops are deemed advisable the injurious competition may be lessened by the use of lighter seedings of the companion crops. When cereals are grown as companion crops the period of competition may be shortened by harvesting the cereals for silage or chaff.

The use of suitable mixtures of pasture seeds is of basic importance. Some detailed information about mixtures was given in these notes in the February, 1934, *Journal*. Further information is available from district officers of the Fields Division.

It is probable that the coming of September will find some pastures still in need of harrowing. Usually it is very advisable to harrow without delay pastures in which stock have been fed during the winter. In particular, fields intended for ensilage or haymaking during the coming season should be harrowed thoroughly a short time prior to closing them from grazing.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Control of Pests and Diseases.

STONE-FRUIT trees should by this time have been sprayed for the control of leaf-curl and other fungous diseases as recommended in the July notes. In addition to these sprays a further pre-blossom application is necessary should the season prove favourable to brown-rot development. Lime-sulphur at a dilution of 0·1 per cent. applied when the majority of buds are at the pink stage is recommended at this period. At the petal-fall stage apply lime-sulphur 0·083 per cent., plus colloidal sulphur (2 lb. to 100 gallons spray). Subsequently the spray-applications needed are governed by local conditions, variety, &c. Under certain adverse conditions it is necessary to repeat the petal-fall spray at intervals of three weeks until the earliest fruits are almost ready for picking. Under more favourable conditions two post-blossom sprays only are required, the first four weeks prior to the anticipated first picking and the second three weeks later.

Pome-fruit trees, if not already sprayed with oil emulsion as recommended in the previous month, should receive this insecticide at an early date and prior to the green-tip stage. Fungicidal sprays necessary prior to the petal-fall stage vary appreciably according to local conditions. The susceptibility of varieties to powdery-mildew and black-spot, prevailing weather conditions, and tender foliage varieties are the principal governing factors. Varieties that are immune, or almost immune, from attack by powdery-mildew should be sprayed with Bordeaux mixture at a strength of 5–4–50 at the green-tip stage: for other varieties lime-sulphur at a dilution of 0·5 per cent. is preferable. This spray should be followed at the tight-cluster stage with an application of lime-sulphur 0·2 per cent., and at the pink stage or advanced open-cluster stage at 0·1 per cent. In certain localities and on varieties not usually infected with powdery-mildew, the tight cluster spray may be omitted, provided there is no danger of early infection of black-spot. The petal-fall spray, which is probably the most important spray of the year, should be applied when not more than 75 per cent. of the blossom-petals have fallen, and on varieties subject to attack by

powdery-mildew when about 50 per cent. of the petals have fallen. This spray should consist of lime-sulphur 0·1 per cent., plus colloidal sulphur 2 lb. per 100 gallons of spray, plus lead arsenate 1½ lb., plus hydrated lime 4½ lb. per 100 gallons.

On pears, excepting for a few tender varieties, Bordeaux mixture at a strength of 3–4–50 is recommended at the tight-cluster spray and all subsequent sprays.

The dilution of lime-sulphur as given above is shown in terms of the polysulphide-content. The percentage of polysulphide in different brands of lime-sulphur varies appreciably. Consequently a table of dilutions is necessary, and copies of this table are obtainable free from all Orchard Instructors. When a lime-sulphur that contains 15 per cent. of polysulphide is used the empirical formula for the dilutions in general use are as follows: 0·5 per cent. = 1–28; 0·2 per cent. = 1–70; 0·1 per cent. = 1–140; 0·083 per cent. = 1–178.

In mixing lead arsenate with sulphur sprays it is important that the correct method should be followed. Faulty mixing of these ingredients not only is liable to cause severe spray injury but also impairs the efficiency of the mixture as a fungicide. In mixing, first dilute the sulphur fully, to the required quantity of lead arsenate add three times its weight of hydrated lime, mix with water to form a thin paste, and pour into the diluted sulphur solution with the agitator working.

Cultivation.

In orchards that have not as yet been ploughed, this work should be proceeded with without further delay and the ground brought to a fine tilth. Early and thorough cultivation is an important factor in promoting healthy tree growth. Trees should be dug around and all decayed leaves, &c., buried, if possible, before the trees commence growth.

Miscellaneous.

The planting of young trees and the pruning of all deciduous trees should be completed by the end of August. Prunings should be burned before tree-growth commences, since certain diseases can spread from the prunings to infest the young growth.

Adequate support for the fruiting-limbs of mature trees is a matter that requires frequent attention. A permanent system of wire-bracing is recommended, and, if possible, should be completed while the trees are in a dormant state. Full details of a system of central wire-bracing fruit-trees appeared in this *Journal*, November, 1932. While it may not be possible to complete the wire-bracing of all trees in an orchard in any one year, an effort should be made to wire at least a portion of the orchard each year, so that ultimately the objectionable and expensive props no longer will be required.

—P. Everett, Orchard Instructor, Gisborne.

Citrus Notes.

Owing to the showery and spring-like conditions obtaining during the autumn, a fair amount of young growth which was produced in many citrus orchards had no time to harden before the winter set in. It is possible that some of this growth may be damaged by frost, and it will not be wise to cut such parts back until all danger of frost is over. However, the work should not be unduly delayed, as dead or dying wood is always more or less injurious to any growing trees.

A careful watch should be kept for any indication of borer, and all cavities should be treated with an injection of benzine, and afterwards

the hole should be blocked with soap or some other plastic material. If only small branches are infected it may be more advisable to cut them out and burn.

The coming month is the most suitable period of the year for planting all varieties of citrus trees. Fair rainfall may be expected to keep the young trees going, and the spring conditions are conducive to early establishment.

Possibly the most important factor in planting is that the soil should be in good condition, well worked, and friable, and not by any means sticky when worked to plant the trees. The trees should be firmly planted, with the roots well spread. The subsoil immediately under the tree should not be disturbed to a greater depth than the surrounding subsoil, and though the soil should be firmed round the spread-out roots the top two inches of the surface soil should be left loose.

If the situation is in any way exposed to wind, young trees should be supported with a strong stake inclined towards the prevailing wind, and securely tied, but in such a way as not to injure the tree, and where possible a temporary shelter should be provided.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Artificial Incubation—*continued.*

It is well to heat the machine slowly, and when the regulator has been adjusted and the temperature of the egg-chamber kept at 102° F. for twenty-four hours it should be quite safe to put the eggs in. Allow the eggs to heat slowly, for heating too suddenly may cause broken yolks. A temperature of 103° F. with the bulb of the thermometer resting on the eggs should give satisfactory results. Special care should be taken to see that the temperature does not go too high, especially during the first week, for a temperatue of, say, 105° F. to 106° F. for even a few hours during that time often results in the death of the embryo, or it may be so weakened that it will die about the nineteenth or twentieth day.

Turning and Cooling.—Eggs are turned in order to give the developing embryo exercise and a fresh feeding-ground, and to prevent the yolk from settling down towards the shell. It is not necessary to turn each egg over; if the eggs are moved gently each day after the second day, and twice each day after the first week up till the nineteenth day, this should be sufficient. The time required for cooling depends a good deal on climatic conditions. Never let the eggs get cold—it is better to return them to the machine while luke-warm—*i.e.*, neither warm nor cold.

Moisture and Ventilation.—If the correct temperature has been maintained, and the eggs not chilled while cooling, and it is found that a number of strong germs die between the first test and hatching-time, one may look to the moisture or the ventilation position in most cases to find the cause. It is advisable to set a hen at the same time as the incubator is set, and to try to keep the air-cells of the eggs in the machine the same as those in the eggs under the hen. It will be found that the air-cells vary in size, but one need only strike an average. If a record is kept about the operation of the incubator showing when, and how much, moisture is applied, when and how the ventilators are worked, and also the temperature morning, noon, and night, it will act as a good guide for future work.

The Setting Hen.

When selecting a broody hen choose one that is quiet and can be handled. Avoid using a wild and nervous bird, and also avoid the hen with scaly

legs, as this trouble is likely to be transmitted to the chicks. All setting hens should be treated for insect pests by dusting with insect-powder, care being taken to see that the powder goes well down to the skin. Another good method of treating insect pests is to dip the end of a feather into nicotine sulphate and draw this under both wings, or among the breast-feathers. If no insect-powder or nicotine sulphate is at hand, a suitable mixture can be made by mixing equal parts of lime, dry earth, and sulphur. The best place to set a hen is in a coop away from other hens where she is not disturbed. A coop about 2 ft. 6 in. square with a run about 6 ft. long, and the same width as the coop serves the purpose. It is not wise to place coops close to stables or buildings, which are apt to attract rats. The nest should be made saucer-shaped and is better on the ground, while care should be taken to see that it is not too deep, or the eggs are apt to pile on top of one another. Have the nest flat on the bottom, and just sufficiently deep to cause the eggs to have a slight tendency to roll towards the centre when the hen turns them. The use of plenty of nesting-material is important to aid the hen to keep the eggs at a desired temperature, and soft, fine straw, hay, or pine-needles are suitable materials. The number of eggs to set under a hen will depend on the size of the hen and also on the size of the eggs. It is, however, always wise to set too few than too many. A hen of the average size of the Orpington, Rock, Rhode Island Red, or Wyandotte breed covers thirteen eggs comfortably. It is always well to remove the hen it is intended to set at night and place her on a few dummy eggs until she gives evidence of settling down.

The setting hen is best fed on grain alone, as mashes, meat, or green feed are apt to have a laxative effect, where the sitting hen is concerned, which may cause the eggs to become soiled, and in the event of this taking place the eggs should be cleaned and fresh nesting-material provided before they are put back in the nest. Grit and clean water should be within reach of the hen at all times, and a box containing some dry earth should be provided as a dusting-place when she comes off the nest. Do not disturb the hen at hatching-time, but when the hatch is completed it is well to remove the empty shells and those eggs that did not hatch. It is seldom advisable to help chickens out of the shells, for if they are not strong enough to get out on their own account they seldom develop into profitable stock.

Artificial Brooding.

In order to get the maximum return from his plant every poultry-keeper practically is compelled each year to renew from one-third to one-half of his flock.

This replacing of stock is probably the most expensive, and in many cases the most difficult, yearly task on large plants. More failures in the poultry business may be attributed to the inability of the poultryman to renew successfully his stock than to any other cause. It is advisable for any one going in for poultry-keeping as a means of providing a livelihood to start in a small way, or, better still, first to get some practical experience in the handling of brooder chickens on a successful poultryman's plant. Unless a poultry-keeper is able successfully to rear a sufficient number of pullets each year to renew his flock, he will find it impossible to make a success of poultry-farming.

Many troubles in chickens are caused by incorrect night conditions, such as over-crowding, over-heating, dampness, or want of ventilation. The successful poultryman is able generally to tell in a moment when he enters the brooder-house if the chickens are a little "off colour," and his practical experience enables him to find the cause and at once remove it.

Owing to the many different kinds of brooders in use, the various classes of chicks one may have to handle, and the almost daily climatic changes

it is impossible, or at least very unwise, to attempt to lay down a set of hard-and-fast rules by which all brooders could be worked successfully. The best brooders supply the chickens with plenty of room, warmth, and fresh air, but if there is a lack of any of these essentials the strain on the vitality of the chickens will be great and only the strongest will survive.

The success of a brooder depends largely upon its system of circulation and ventilation of air. Some fail in this respect, and the chickens are compelled to rebreathe the same impure, confined air. Such brooders are little short of death-traps, as breathing of bad air is very harmful for the chickens. After the chickens are a few days old it may be noticed that they do not come from under the hover briskly in the morning and appear stupid and dull for a few hours, but liven up as the day does on. The cause of this often is lack of fresh air at night, and in such cases it would be well to allow a little more ventilation just after the chickens have settled down for the night. There are many different styles of heated brooders on the market, and instructions as to their working are usually sent out by the makers, and it is well for beginners to follow these instructions carefully.

Some of the best results from the use of the canopy class of brooder have been obtained when the brooders were worked on a frame, in order to keep the chickens off the ground and allow air under their bed at night. Full particulars regarding the use of these frames may be seen in the Department's Bulletin No. 66, " Utility Poultry-keeping," copies of which may be had from the publisher, Department of Agriculture, Wellington ; price 1s., postage free.

Ground draughts should be guarded against, as they are at times the cause of chickens huddling. The chickens should be watched carefully as they camp for the night to see that they do not crowd to one side of the hover, and if they do this they should be gently spread out. This is one of the important details in connection with artificial brooding of chickens. Whatever class of brooder is used, the chickens should be somewhat confined during the first few days, or at least until they know what to do and where to go when they require warmth. The lack of this attention or training during the first few days is often the cause of the chickens getting chilled.

The heat of the brooder should be gradually reduced and more ventilation allowed as the chickens develop. Generally speaking, Leghorn chickens may be placed on the perches when between six and seven weeks old.

—C. J. C. Cussen, Chief Poultry Instructor, Wellington.

THE APIARY.

Early Season Examination of Colonies.

With the advent of warmer weather advantage should be taken of the fine days to make a preliminary examination of the hives. Provided that the colonies were queen-right in the autumn and had ample stores for the winter period, very little harm can come to them during the opening months of the spring. It is not sufficient, however, to conclude that all is well because the bees are flying freely and numbers of them are carrying pollen into the hives. These activities obtain even up to the point of starvation, and if taken as a guide to the condition of the hives may end in wholesale losses. To ensure, therefore, that all is well a critical examination should be made as early as possible. Although it is an advantage to postpone the spring examination until the bees are working fruit-bloom and early nectar plants, if it is thought the colonies need attention the work should not on any account be delayed. It must be remembered that the drain on the stores is enormous once brood-rearing has commenced. Everything should be in readiness before opening up the hives. The smoker should be going well, and the beginner would be well advised to protect himself with a good bee-veil properly adjusted.

Breeding.

Normally in September colonies should have a good quantity of sealed brood. If, however, there is absence of brood this points to a poor queen or to the likelihood that the hive is queenless. To attempt to carry such colonies through the spring months will lead to serious trouble, as they stand in danger of getting robbed. It is a far better plan to unite such colonies than run the risk of disturbing the whole apiary. A simple method of disposing of weak and queenless hives is to unite them with strong ones, and this may be carried out by placing a sheet of newspaper over a strong colony and putting the hive to be united on the top of the paper. In the course of a day or two the hive may be examined to see that the colonies have united. Should the paper be intact it must be torn in several places. It will be found in the course of a few days that the colonies are working peaceably. It is essential that breeding should be kept going steadily, so that the colonies will be strong in young bees to take advantage of the first flow of nectar. Food and warmth are important factors in inducing breeding, and these must have the constant attention of the beekeeper during the spring months.

Food-supply and Feeding.

As already indicated, the spring is the most critical period of the year for the beekeeper, and the success or otherwise of the season's work will depend almost entirely upon his efforts to guard against the losses attendant upon starvation. Large losses occur annually through neglect in this direction. When breeding is in full swing a considerable amount of food is used up daily for feeding the brood; and, unless the weather conditions are favourable to enable the bees to work the early spring blossoms, it is essential that the food-supply be augmented. The amount of nectar gathered when the weather is favourable, in conjunction with their stores, tides the bees over long periods, but if bad weather follows, colonies often are reduced to a state of starvation before the owner is aware of their condition. If on examination a colony is found with insufficient stores to meet requirements, preparation should be made to feed it at once. It is not a safe policy to keep a colony at starvation-point, as this prevents the rearing of a succession of young bees to take the place of the rapidly dwindling number of workers at this period.

There are many feeders on the market which can be utilized for the purpose of supplying food. The division-board feeder is the best to use at this season, as it serves the double purpose of feeder and division-board in cases where the colony is not strong enough to occupy all the frames in the hive. When making an examination of a hive to note its condition the feeder should be placed in the hive in readiness if it is anticipated that artificial feeding will have to be resorted to at a later period. All feeding should be carried on within the hives. Especially guard against feeding at the entrances, as that surely produces trouble. Place the feeder on the warm side of the hive, and in cases where the clusters are small the feeder can be inserted in position next to the cluster.

A point to remember in connection with feeding is that it creates an artificial flow and is stimulating, and, when started, it must be carried on until a natural flow from the fields sets in. If there is a suspicion of disease in the apiary, do not attempt to feed honey. In any case it is not wise to use honey taken from another hive, as it is impossible to be sure of its source. Feed only the best white sugar. It is a good plan to feed in the evening, as the discovery of the syrup excites the bees, and the colony has time to settle down before the morning, and there is less likelihood of the other colonies learning the cause of the excitement. A syrup composed of two parts of water to one of sugar, fed slightly warm, proves the best artificial feed for bees in the spring.

Detection of Foul-brood.

As suitable weather permits, every hive should be opened, one at a time, and a strict examination made for symptoms of foul-brood. If it is present, do not fail to mark colonies for treatment. Mild cases can be treated at a later period in the season, but if a colony is affected badly it is by far the safest plan to sulphur the bees and remove the combs to a place of safety. These combs can be converted into wax when a sufficient number warrant the undertaking. If isolated capped cells are discovered, these should be treated as suspicious. Healthy brood-cells are convex in form, bright in appearance, and in contrast differ greatly from diseased cells. These latter are slightly darker, concave in form, and are frequently perforated. Diseased cells of last season's production are usually so shrunken in appearance as to be easily detected, whether they are in an isolated position or surrounded by healthy brood.

Precautions against Robbing.

Every precaution should be taken to prevent robbing getting a start in the apiary. Robbing may be caused by exposing combs too long when manipulating the hives, by careless feeding, and by the presence of weak and queenless colonies. These latter should not be tolerated, and the other causes can be obviated by care and attention. On no account should combs be exposed for long intervals, and if feeding has to be undertaken it should be deferred until late in the day. The excitement caused by feeding attracts other bees, and once they have tasted the material being fed they will continue to molest the hives for many days. As soon as robbing is detected it is far the best plan to postpone all operations in the apiary, and the entrances to the hives should be contracted at once. If a colony is in danger of being robbed it may be saved by piling wet grass in front of the entrance. Robbers are less likely to enter a hive so protected. The important fact about trouble from robbing is that prevention is the best plan in all cases. On no account spill syrup near the hives, do not leave combs lying about, and try to avoid weak and queenless colonies. One will then not be troubled with robbing.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

On sandy lands by the seashore sea-kale is a perennial crop that is easily grown; such localities in Europe are its natural home. As the crop is harvested in the spring, it is of special value, as there is usually but little variety at that season. It may be grown from seed or root-cuttings. Seeds may be sown now in rows of 1 ft. or so apart and the plants thinned to a distance of 6 in.; they will then be ready for planting out permanently after twelve months' growth. Planting is done at a distance of 2 ft. between plants and 2½ ft. between the rows. Root-cuttings give a quicker return; they are made from pieces of root about the thickness of a pencil and about 4 in. or 5 in. long. It is convenient to cut the tops square across and the lower end with a slanting cut. These should be planted out now in rich ground well prepared in an open position, where the crop should produce well for five years or more. The top of the cutting should be 2 in. below the surface of the ground. A number of growths will appear from each cutting, but all should be removed except the strongest. Occasional applications of nitrate of soda bring the plants along strongly. The crop has a fairly wide range of adaptability, and need not be confined to the localities mentioned. When planting out seedlings now the crown of the root must be

cut off or the plant will produce a flower stem, which should never be allowed. A number of growths from the one plant develop; but they should all be removed except the strongest—as is done with root-cuttings.

The plants die down in the winter, when the beds should be cleaned up. Before growth commences in established beds, each plant should be covered with a box or pot to exclude the light; a tender blanched growth 8 in. or 10 in. long is the result. This always should be cut with a portion of the crown of the root, and the plant then allowed to grow naturally, the shoots being thinned, leaving only one or two of the strongest to complete growth. To do this satisfactorily a good dressing of manure should be applied and worked in during early summer.

A dish of moderate-sized leeks well grown has very much the flavour and attraction of good asparagus. The leek is a very hardy crop and subject to very few troubles of any kind. It is a reliable crop in fairly rich land in any climate. To produce plants for setting out towards the end of the year in land from which an early crop has been cleared a generous sowing should be made now.

The most delicious of the cabbage family are the Brussels sprouts, and very fine crops are now being grown here in the cooler districts. As they require rather a long season to complete their growth, they are sown thinly towards the end of September, and planted out about the month of November in a piece of ground which has been well manured and cultivated and from which an early crop of peas, &c., has been taken. To obtain the firm solid sprouts that are desirable good thrifty growth is necessary, and this is obtained by planting them out in ground that has become consolidated and has not been dug recently. An application of nitrate of soda or sulphate of ammonia may be made when the plants have become established, but it is to be remembered a too generous application of manures is detrimental.

The popularity of green peas demands a generous supply, to maintain which a sowing of mid-season variety should now be made. A rich, moist soil in which lime and phosphates have been included suits garden peas best.

Main-crop potatoes are usually planted during the months of September and October. While a rich, light loam is most suitable for the crop, it is often planted in rough land newly broken in, with a view to cleaning it and bringing it to a fine tilth. For this purpose the potato crop is very suitable. Rough dirty ground is quite unsuitable for fine seeds, and, while it may not grow a heavy crop of potatoes, it usually gives a potato crop equal to or better than any other crop that is obtainable from land in that condition. In addition, the hoeing, moulding, and digging aerate and sweeten the land as well as destroy the weeds. It is for these reasons that the potato is popular for assisting in breaking in new land.

In warm humid localities where early potatoes may be grown, but late crops are seriously subject to disease, kumaras are a very good alternative crop. They are grown from slips produced from tubers sprouted on a hot-bed. After making up the hotbed and allowing it a few days to settle down, spread 1 in. of clean sand, then sound kumara tubers close, but not touching. Then cover to a depth of 4 in. with clean sand or sandy loan. Water the bed thoroughly with a water-can, and keep it moist: great care is necessary in this, and it is safer to keep it rather on the dry side. In four or five weeks the tubers sprout, and when the shoots are 6 in. in length they should be removed carefully. At this stage they should have sufficient roots to sustain them. They should then be heeled closely, in a well-sheltered sunny position, and provision made so they may be covered readily should there be any danger of frost. Here they harden off and make root in readiness for planting out from the middle to the end of November. A sandy loam well sheltered is ideal for planting out this crop.

As the value of fresh salads is now generally appreciated, radishes and lettuce should be sown. And for those who appreciate a variety of vegetables salsify may be sown 1 in. deep in rows 15 in. apart. It has few enemies, and provides a generous crop of roots for winter use.

Where interest is taken in herbs, seeds of coriander, caraway, angelica, dill, aniseed, summer savory, and sweet marjoram may be sown ; the latter must be treated as a half-hardy annual, the remainder are quite hardy. Cuttings, with a heel of old wood, of sage, rosemary, lavender, and thyme may be taken and rooted in a moist sandy soil. Spearmint, peppermint, tarragon, and chives may be propagated by division.

Tomatoes and other half-hardy crops sown in boxes which are placed on a hotbed towards the end of August should be pricked out into other boxes as soon as they are big enough to handle. No artificial manure should be used with the soil, except that when the soil is poor a little fine bone-meal may be added. The boxes of seedlings should be returned to the hotbed and watered with tepid water through a fine rose. When the plants are established it is advisable to ventilate freely in fine weather and encourage steady growth in moderate temperatures.

Tomato Crops under Glass.

In the unheated glasshouse the tomato requires close attention at the present time owing to the changeable weather. Much has been said about the need of ventilation and of a dry atmosphere for this crop under glass, but the remarks apply chiefly to the early summer period when the house is crowded with growth. There is little danger from excessive humidity now, and a cold draught may seriously retard the crop. During the spring-time ventilators must be adjusted with every change in the weather so that steady growth is maintained ; and when late frosts threaten a few heaters of some kind should be at hand to meet the emergency. It is advisable to avoid forcing the growth when the lower bunches are setting, and to assist them, if necessary, by jarring the strings on which the plants are trained, by rapping them smartly with a light cane or by drawing the cane quickly along the rows of twine ; this should be done about noon in fine weather. Shallow cultivation to break up the surface crust and destroy weeds is beneficial, and tepid water should be applied during the morning as required. Sturdy plants with plenty of blossom is the object in view ; rank soft growth, and poor setting are due often to high temperatures, excessive watering, and a loose rich soil.

Small-fruit Crops.

Light cultivation to destroy weeds and encourage growth should be given as necessary. Deep cultivation must be avoided carefully at this season or irreparable damage will be done to the fruit crop. Established plantations from which heavy crops are expected generally benefit from a dressing of fertilizers worked in about the time growth commences.

The planting of all hardy crops of this class should now be completed at the first opportunity during fine weather. Those crops which are inclined to be rather tender during the early stages of growth, such as passion-fruit, tree tomatoes, and Cape gooseberries, may be planted towards the end of October.

The Homestead Garden.

New lawns should be trimmed as soon as the grass is long enough for cutting ; use a mower that is in good order and set it high, generally as high as possible. Cut the lawn when the grass is dry and afterwards roll it with a light roller. When old lawns become thin and weedy this usually is due to a lack of fertilizing treatment. Applications of 3 parts sulphate of ammonia and 1 part of sulphate of iron are a popular dressing to suppress the weeds, but it is also necessary to manure the grasses and obtain a vigorous growth, so that weeds have little chance of again becoming established. On light land a rich dressing of complete manure of organic origin is most suitable. It should be in a dry friable condition so that it may be spread easily and may quickly work down to the roots of the grasses. On heavy land the dressing may be composed chiefly of artificial fertilizers well mixed with sharp sand. Early spring is the most suitable time for making these applications.

Rose-pruning should now be completed. Cut away the weak wood on young plants and shorten the remaining growth to 3 in. or 4 in., cutting just above buds that are pointing in an outward direction. This is considered destructive by those who are unaccustomed to the work, but it is not long before the treatment is justified by growth far exceeding that on bushes of the same age which have been pruned lightly. The bushes also become more shapely and develop other important characteristics.

Prick off half-hardy annuals out of seed-boxes, setting the young plants down almost to the seed-leaves. Firm the roots in the ground, but not the stem at the surface ; the stem is very tender and liable to serious injury.

The decorative character of many pot-plants make them very desirable ornaments at times ; they are also most economical if they are used appropriately. Palms, *Begonia rex* varieties, aspidistras, asparagus species, and ferns dislike much sun, and should be given shady situations. Warm, sunny positions are suited to geraniums, pelargoniums, and members of the cactus group. All pot-plants soon show signs of distress if fresh air is lacking, and cold draughts are equally injurious. The water used should be of about the temperature of the atmosphere, so it is often advisable to "take the chill off" in cold weather. Where potting or repotting is necessary, it is generally best done about the month of September. It is usually done satisfactorily, but improvement may sometimes be made by seeing that the roots of the plant to be operated on are moist, but not very wet. The plant should be repotted a day or two after watering. After setting the plant in a fresh pot, water it in, but withhold water afterwards until growth recommences and more water is obviously required. Results depend very much on the soil mixture used ; most of the plants above-mentioned require rather a rich soil with plenty of humus (decaying organic matter, chiefly vegetable, such as leaf-mould) and sand to keep it open and prevent it setting hard. Equal parts of good loam, leaf-mould, and sand with the addition perhaps of a little fine bonedust suit most of those above mentioned. Where the soil is light, it is usually advisable to increase the loam and halve the quantity of sand used. Geraniums and pelargoniums should be potted firmly in a soil composed of 3 parts good loam, 1 part decayed manure, a little coarse sand, and a rather generous addition of bonedust.

—W. C. Hyde, Horticulturist, Wellington.

For Sale at Wallaceville Poultry Station.

SITTINGS OF HEN EGGS.

White Leghorn, **6s. 6d.** per dozen, rail or postage free.

From specially-selected stock—
White Leghorn, **12s.** per dozen, rail or postage free.

Incubator lots—
8 dozen or more, **5s.** dozen, railage free. If to be sent by post, **1s.** per dozen extra.

DAY-OLD CHICKS.

	Under 50.	50 to 99.	100 and over.
White Leghorn	1s. each. (25 = £1 - 5 - 0.)	11½d. each. (50 = £2 - 8 - 0.)	11d. each. (100 = £4 - 11 - 0.)

NOTE.—Chicks cannot be sent through the post. Price free on rail, Upper Hutt.

PULLETS.

10 weeks old, **6s.** each, available after 1st November.

Orders must be accompanied by the proper remittance. Cheques and money-orders should be made payable to the "Department of Agriculture." **Cheques must have exchange added.**

Apply to the POULTRY OVERSEER, Wallaceville Veterinary Laboratory, Private Bag, Wellington.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

CREOSOTE AND FLAVOUR OF CREAM.

A. F. R., Swanson :—

It is proposed to build a shed for separating and keeping the cream on the off days. If the timber is coated with creosote would this have any harmful effect on the cream ?

The Dairy Division :—

It is probable that the smell of creosote would affect the flavour of the cream for quite a considerable time after using the creosote as specified. A separator-room is not a desirable place in which to keep cream, especially if attached to a milking-shed : a small shelter provided with ample ventilation at some distance from the shed is much better.

PAINT NOT DRYING.

E. M., Great Mercury Island :—

I mixed white zinc with *boiled* oil, and red lead with *boiled* oil, and neither paint dries, though washed with turpentine, and though the white was also painted over with a coat of quickly drying flat paint. (*a*) What are the specific differences between, and uses for, boiled, as opposed to raw, linseed oil ? (*b*) Is red oxide (of iron) the only metallic oxide forming a drying paint with boiled oil ? (*c*) By any means other than removal by blowlamp is it practicable to dry the paint mixed with boiled oil already applied ?

The Chief Chemist :—

The trouble probably lies in the oil not being really *boiled* linseed oil but something else such as *raw* oil or fish oil. Alternatively, trouble might be due to the surface painted not being clean. If it had already been painted with fish oil or bituminous paint or was oily, trouble might be experienced. (*a*) Boiled oil contains dryers, whereas raw oil does not, consequently boiled oil dries more quickly than raw oil. Boiled oil is darker in colour and more viscous than raw oil and hence has a lower penetrating-power. It is usual to use a mixture of boiled and raw oil. (*b*) Many metallic oxides form drying paints with boiled oil. White zinc and red lead both do so. (*c*) Probably removal of the paint is the only remedy if it fails to dry on standing.

ABNORMAL LIVER IN PULLET.

M. E. W., Greatford :—

The liver of a dead pullet was twice or three times the normal size and spotted with what looked like fat, more than anything else, though one large spot had turned to a cyst. She was laying and had an egg ready to pass. Otherwise she seemed in excellent condition, though a little over fat. What is the cause of her death, and is it infectious ? The combs of several other birds in the same flock apparently started to colour and then lost the colour again. Is this likely to be due to the same cause ? If so, what preventive measures should be taken ?

The Live-stock Division :—

Without examining the stock it is not possible to say definitely what the nature of the trouble is, but probably it is a case of " enlargement of the liver," which is usually caused by improper feeding and want of exercise.

The feeding of too much rich food such as meat, meat-meal, or too much maize and wheat, with insufficient mash and green feed, may be the cause. If only one bird is affected, however, it is not advisable to make any change in your feeding, especially at this time of the year. If, however, other birds are showing signs of being affected in a similar way, it would be advisable to send an affected bird for examination to the Officer-in-Charge, Veterinary Laboratory, Wallaceville, Wellington, accompanied by a letter describing the condition of the flock. In the meantime give the birds more exercise by making them work for their grain in deep litter and increase the supply of green feed.

WEATHER RECORDS: JULY, 1935.

Dominion Meteorological Office.

NOTES FOR JULY.

THE weather in July showed some remarkable contrasts both in character and location. In most parts of the country, however, in the period up till about the 23rd, with the exception of a cold break from the 7th to the 10th, many days were mild for the season of the year, and there was evidence of this in the early blooming of spring plants and an appreciable growth in pasture. During the remainder of the month, on the other hand, conditions were cold owing to persistent and, at times, strong southerly winds prevailing. Accounts received indicate that in most localities grass was relatively plentiful, although in some it was necessary to resort to supplementary feeding, and on the whole stock kept in good condition. In the South Island the weather was favourable to all farming pursuits, so that winter sowing of wheat and oat crops appears to have been above the average.

Temperatures.—Temperatures did not vary greatly from the average, the difference being mainly a negative one, but at a few places about Cook Strait and on the east coast of the South Island it was slightly above.

Rainfall.—Rainfall over the whole of the South Island and in parts of the Taranaki Bight and central area of the North Island was below the average, while in the remainder of the North Island it was above. The largest differences above occurred in the North Auckland district, where, in places, it was more than double and the highest July fall ever experienced. The greatest deficiency was experienced in the western and southern areas of the South Island.

Storm Systems.—In contrast to the preceding month, July was remarkably free from severe widespread storms, although frequent depressions passing over or in close proximity to the Dominion caused disturbed conditions in different districts according to their exposure to the winds associated with these various low pressure systems.

Strong southwest winds prevailed on the 1st, a severe gale from that quarter blowing along the east coast of the South Island in the afternoon and evening. By the morning of the 2nd, however, the southerlies had decreased in force and a decided improvement in the weather set in.

On the 5th a cyclone, which had been moving slowly across the Tasman Sea, had reached northern New Zealand, and the weather rapidly clouded over. This disturbance brought almost general rains, except in Westland, between the 6th and 8th, heavy falls and some flooding occurring at places in the northern and eastern areas of the North Island. It passed away off East Cape during the night of the 7th, but a series of slight secondaries continued to move north of New Zealand, and the easterly winds associated with these brought intermittent rains to the northern and east coast districts of the North Island until the 10th, while the remainder of the Dominion was experiencing fine weather under the influence of an anticyclone.

From the 19th to the 23rd an intense anticyclone lay over New Zealand, but its central portion was situated in the south. At the same time a series of slight depressions passed to the north, and the far northern and eastern areas were again subject to scattered and, in places, heavy easterly rains. Otherwise the weather was fine in most parts of the country.

By the morning of the 24th the high-pressure system had passed away and a depression had moved on to northern New Zealand. The centre of this depression moved slowly across the North Island, passing in a southeast direction to the vicinity of the Chatham Islands on the 26th, where it became very intense, pressure at the Chatham Islands falling as low as 28·77 in. on the following day.

RAINFALL FOR JULY, 1935, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
North Island.						
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	7·35	16	2·05	5·48	40·34	33·64
Russell	12·19	18	2·70	5·27	65·82	32·60
Whangarei	14·06	22	3·41	7·19	57·18	38·79
Auckland	10·55	19	3·38	5·58	43·12	29·86
Hamilton	..	..	..	5·10	..	29·00
Rotorua	5·24	17	1·58	5·00	43·84	31·85
Kawhia	..	..	..	6·01	..	31·55
New Plymouth ..	6·88	18	1·44	6·38	48·79	34·92
Riversdale, Inglewood ..	7·85	16	1·69	10·06	73·53	58·71
Whangamomona ..	4·92	7	1·61	7·27	53·96	42·97
Hawera	5·04	16	1·33	4·22	38·95	25·61
Tairua	10·54	20	2·27	6·31	51·03	39·87
Tauranga	5·65	19	1·15	4·94	41·81	31·82
Maraehako Station, Opotiki	3·16	14	0·96	4·45	49·06	32·24
Gisborne	6·28	21	1·45	5·05	31·25	29·96
Taupo	4·33	13	1·13	3·87	33·93	25·23
Napier	10·48	18	3·55	3·27	37·62	19·35
Hastings	6·35	16	1·55	3·66	27·85	20·29
Whakarara Station ..	12·83	23	4·85	..	45·68	..
Taihape	1·75	17	0·32	2·97	22·08	20·78
Masterton	6·04	18	1·25	4·18	24·30	22·95
Patea	3·83	19	1·39	4·23	35·38	25·63
Wanganui	1·69	13	0·39	3·34	25·70	21·04
Foxton	1·79	10	0·52	3·31	20·90	18·38
Wellington	4·32	14	1·18	4·85	21·47	25·74
South Island.						
Westport	4·01	12	1·60	8·30	53·96	54·80
Greymouth	3·95	7	1·44	7·93	59·90	57·49
Hokitika	3·22	8	1·32	8·96	71·48	64·05
Ross	3·40	5	1·50	9·18	69·53	71·95
Arthur's Pass ..	4·69	6	2·60	9·93	82·01	85·87
Okuru, South Westland	2·42	4	1·00	10·52	66·98	82·56
Collingwood	4·38	11	1·48	9·40	57·63	54·96
Nelson	2·31	6	1·40	3·48	27·13	21·80
Spring Creek, Blenheim	1·89	8	0·73	3·42	16·37	17·89
Seddon	1·27	12	0·33	2·40	10·78	14·72
Hanmer Springs ..	3·46	16	0·98	4·29	23·97	26·06
Highfield, Waiau ..	1·90	11	0·52	3·34	15·41	20·08
Gore Bay	2·21	9	0·99	2·80	13·78	18·67
Christchurch	1·06	13	0·28	2·54	12·72	15·17
Timaru	0·56	5	0·20	1·84	13·17	12·98
Lambrook Station, Fairlie	0·68	7	0·30	2·62	14·53	14·60
Benmore Station, Clearburn	0·77	3	0·72	1·74	14·05	14·54
Oamaru	0·86	9	0·26	1·72	12·58	12·70
Queenstown	0·28	3	0·22	2·03	20·20	17·38
Clyde	0·21	1	0·21	0·90	10·90	8·66
Dunedin	1·30	13	0·20	2·98	23·93	21·06
Wendon	0·61	6	0·33	1·74	23·13	17·22
Balclutha	0·56	7	0·20	1·78	21·08	14·49
Invercargill	1·78	16	0·40	3·27	32·96	26·58
Puysegur Point ..	5·18	14	1·14	6·15	52·91	48·41
Half-moon Bay ..	3·68	17	1·97	4·40	35·20	33·53